HERRING TAGGING IN THE VICINITY OF THE SCOTIAN SHELF AND GULF OF ST. LAWRENCE BY THE MARITIMES REGION, 1973-1982

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ABSTRACT

Stobo, W.T. and Fowler, G.M. 2009. Herring tagging in the vicinity of the Scotian Shelf and Gulf of St. Lawrence by the Maritimes Region, 1973-1982. Can. Tech. Rep. Fish. Aquat. Sci. 2851: iv + 69 p.

Between 1973 and 1982 over 341,000 herring were tagged throughout the Bay of Fundy, Scotian Shelf, and southern Gulf of St Lawrence to examine stock structure and movements. Every major herring fishery in these areas was a subject of this decade-long tagging program, which attempted to distinguish the various known and suspected spawning components perceived at the time. Much of the data has never been examined, and for some areas, previous examinations utilized only early tag recoveries. Our examination suggests that current understandings of stock identities and migration patterns might warrant reconsideration or modification. This is especially true for juvenile herring stock components, but also for a number of adult components.

RÉSUMÉ

Stobo, W.T. and Fowler, G.M. 2009. Herring tagging in the vicinity of the Scotian Shelf and Gulf of St. Lawrence by the Maritimes Region, 1973-1982. Can. Tech. Rep. Fish. Aquat. Sci. 2851: iv + 69 p.

Entre 1973 et 1982, on a procédé au marquage de plus de 341 000 harengs dans l'ensemble de la baie de Fundy, du plateau néo-écossais et du sud du golfe du Saint-Laurent afin d'étudier la structure et les migrations du stock. Dans les eaux susmentionnées, chaque grande pêche de hareng a été assujettie pendant dix ans à ce programme de marquage, qui visait à distinguer les diverses composantes de reproducteurs connues et celles dont on soupçonnait alors l'existence. Une bonne partie des données recueillies n'a jamais été examinée et, dans le cas de certaines zones, les examens réalisés se sont limités aux premières étiquettes récupérées. Il ressort de notre examen que nos connaissances actuelles sur l'identité des stocks et sur les régimes de migration mériteraient peut-être d'être revues ou modifiées. Cela est tout particulièrement le cas pour ce qui est des composantes de stock constituées de harengs juvéniles, mais concerne aussi un certain nombre de composantes de harengs adultes.

INTRODUCTION

Herring have been commercially fished off the Atlantic coast of Canada since the mid 1800s (Scattergood and Tibbo, 1959). During the latter half of the 1950s, the herring catch in the Bay of Fundy represented over 70% of the total Canadian Atlantic coast catch; and the catch on the New Brunswick side of the Bay, taken primarily in weirs, represented over 50% of the total Canadian Atlantic coast catch (Anthony and Waring, 1980). Although these fisheries exploited both adults and juveniles, at various times during the year, the stock relationships were not known; hence the fishing mortality rates being exerted on individual populations were poorly understood. For effective management of the stocks, research was needed on stock movements, migrations and inter-mixing.

Tagging herring in the northwest Atlantic began in 1957 (McKenzie and Skud, 1958; McKenzie and Tibbo, 1958) (see Appendix 1 for release sites). The primary objective of these early studies was to assess the impact of proposed tidal barrages at the entrance to the Passamaquoddy Bay to harness tidal power. They concluded that 1) juvenile herring tagged within Passamaquoddy Bay largely stayed within the Bay, 2) there was a net movement into Passamaquoddy Bay from tagging sites just outside the Bay, 3) some movement, from the sites at the entrance to Passamaquoddy Bay and around Grand Manan Island, further into the Bay of Fundy towards Pt. Lepreau, 4) some juvenile herring tagged along the eastern coast of Maine moved into New Brunswick coastal areas, 5) limited movement from the New Brunswick area along the Maine coast in the eastern Gulf of Maine, 6) no movement from any of the tagging releases into the western Gulf of Maine, and 7) no movement of herring across the Bay of Fundy. However, over 50% and 90% of the recoveries were made within 10 days and 5 weeks of release respectively, and the maximum distance travelled, except for two fish recovered on the Nova Scotia side of the Bay of Fundy, was 34.4 km. Post-recruitment (adult) movements of the Bay of Fundy population was not observed.

The next significant herring tagging event occurred in the southern Gulf of St. Lawrence and off southern Newfoundland in 1970-71 (Hodder and Winters, 1970; Winters and Beckett, 1978). The fishery in these areas prior to the early 1960s was in the order of 35,000 mt., but increased rapidly to close to 300,000 mt by 1970, only to decline as dramatically thereafter (Stobo et al., 1982). This increase in landings was due to a combination of the development of a herring fish meal industry and a large purse seine fleet. A major tagging study of adult herring was initiated due to a lack of understanding of the structure or abundance of stock(s) supporting this expanding fishery. Winters and Beckett (1978) concluded that the herring stock complex supporting the spring-to-fall herring fisheries in the southern Gulf of St. Lawrence also supported the over-wintering fishery off southern Newfoundland. Consequently, the adult component of the southern Gulf complex of spring and fall spawners was being exploited almost year-round during the different phases of its migration cycle. The study did not draw any connections between the southern Gulf complex and the overwintering fisheries developing in the Sydney Bight and Chedabucto Bay areas of Cape Breton, Nova Scotia. This may have

been due to the lack of fish meal plants in Cape Breton, and thus the absence of returns from these areas.

Herring fisheries on the Scotian Shelf also dramatically expanded in the early 1960s, in part due to the same reasons as for the southern Gulf of St. Lawrence, but also due to the development of a major offshore foreign effort (Stobo et al., 1982). Associated with these developments, herring fisheries came under quota regulation by the International Commission for the Northwest Atlantic Fisheries (ICNAF). Concern for the herring stocks identified a need to examine stock relationships to determine population-specific exploitation status of the various herring stock components on the Scotian Shelf. A major tagging program was initiated in 1973 in the southern Gulf of St. Lawrence, along the outer coast of Nova Scotia and along the coasts of New Brunswick and Nova Scotia in the Bay of Fundy, to investigate stock relationships.

The purpose of this report is to provide an overview of the results of the 1973-82 studies. Portions of the database have been analysed to address specific issues (Stobo, 1976b, 1982, 1983, 1987; Stobo et al., 1975), but none have dealt with the data in a comprehensive manner. Description of the database that contains the herring mark:recapture data is available in Stobo and Fowler (2006). We hope that this report will encourage others to further examine these data for insights into herring biology and stock relationships.

HISTORY OF HERRING TAGGING

Tagging, as a means of determining fish movements and stock relationships, has been a research tool since the late 18th century (see McFarlane et. al., 1990). Tagging studies on herring, however, did not begin until the 1930s, when Rounsefell and Dalgren (1933) used internal magnetic tags to determine the migration patterns of herring off the Pacific coast of Canada. This technique was subsequently used extensively on the Pacific coast to investigate herring movements along the British Columbia coastline (eg. Hart and Tester, 1937; Hart et al., 1941; Taylor, 1964).

In European waters herring tagging was not initiated until the late 1940s due to long-standing opinion that herring were too delicate to withstand the tagging operation, their flesh was too soft to retain tags, and the methods of handling herring would make the detection of recaptured fish difficult (Parrish and McPherson, 1961). Once attempted however, herring were tagged extensively (eg. Fridriksson and Aasen, 1950; Hoglund, 1955; Aasen et al., 1961).

Herring tagging on the Atlantic coast of North America first occurred in the Bay of Fundy in 1957 and 1958 (Appendix 1). Over 137,000 juvenile herring, from a number of weirs along the southwest New Brunswick and eastern Maine coastal areas, were marked with opercular tags (McKenzie and Skud, 1958; McKenzie and Tibbo, 1961). Recovery rates ranged from 0-24%, but the overall rate was 2.8%, and between 80-90% of the recoveries were made within a month of release (McKenzie and Tibbo, 1961). These

results created the same impression as held in Europe that tagging was not a successful scientific tool for herring. Herring tagging did not occur in the northwest Atlantic again until the early 1970s.

In 1970 and 1971, the feasibility of using the internal magnetic tags used by Rounsefell and Dalgren (1933) was tested in the southern Gulf of St. Lawrence and off southern Newfoundland (Hodder and Winters, 1970; Winters and Beckett, 1978; Winters, 1977a, Winters 1977b), with the insertion of over 90,000 magnetic tags in adult herring (Appendix 1). This tag was used since almost all the herring caught at that time (purse seine gear was the major component of the fishery) were processed as fish meal, and visual detection of tags by processing plant personnel was considered extremely unlikely. The tags were recovered using magnetic separators inserted in the processing lines of the reduction plants. Recovery rates were again quite low, between 0.4-5.5% (see Winters and Beckett, 1978). While most of the recoveries were made within a few months after release, time at-large was as long as 2 years, thus the tags were deemed adequate to depict herring movements in the Gulf of St. Lawrence area.

In the mid 1960s, an externally applied anchor tag was developed (Dell, 1968), utilizing a unique applicator which allowed the rapid application of tags, and thus the potential for reduced handling time. This tag was introduced in the northwest Atlantic in 1973, for tagging herring (Stobo, 1976a), and subsequently became the preferred tag for herring studies (eg. Hay and McKinnell, 2002; Stobo, 1983; Creaser and Libby, 1988; Moores and Winters, 1984).

The utilization of tagging as a means to examine stock structure and movements led to a number of studies to investigate the potential causes of the low recovery rates of tagged herring. Parrish and McPherson (1961) reviewed the success of a variety of existing tags used in European herring studies. They suggested scale loss was a major factor in tagging mortality, due to osmotic stresses, and hence methods of capture and handling during the tagging operation were important. Tag type and retention were also important, not as mortality factors, but as recovery factors. Attachment type mattered since the soft flesh of herring allowed many tag types to pull out; and the visibility of the external portion of the tags could be important for detection of the tags in processing plants.

Nakashima and Winters (1984) conducted studies to assess the effect of holding time and the relative merits of seven external tags. In one set of experiments, they released some of the tagged fish on the day of capture, and held others for 2 and 3 days before release. They found that the percentage of recaptures decreased the longer the fish were held, attributing the decline to short-term mortality. By comparing mortality rates derived from catch curves based on annual tag recaptures and cohort analyses, they concluded that, for all tag types, there was a substantial long-term tag loss rate or tag-induced mortality. They also concluded that anchor tags were the most suitable to use on herring, due to the high application rate and longevity of returns.

Joensson and Scabell (1984) conducted *in situ* cage experiments to examine tagging mortality. They found an initial period of low mortality, followed by a period of increasing mortality which peaked at 6-7 days, then decreased. They found a significant relationship between the duration of holding time (time required for removal from the capture gear, tagging, and transfer to the holding pens) and the mortality of both tagged and untagged herring.

Hay (1981) brought captured herring into the lab and acclimated them, with feeding, for 4-14 months. He did not indicate the level of mortality during the acclimation periods. The fish were then tagged with anchor tags and monitored them for 6-18 months. He found that 74% of tagged fish held for 6-months survived and retained their tags, while 16% and 36% of two groups held for 18-months, survived and retained their tags. But he also found tag shedding rates of 10%, 22% and 26% in the 6-month and two 18-month tests respectively, and felt shedding was the major issue for the anchor tags.

Stobo et al. (1992) conducted lab experiments to assess short-term herring mortality associated with two sizes of anchor tags. The experiments were terminated after 21 days since the fish were not feeding, and it was considered that starvation could become a mortality factor. Compared to the control group, they found a significantly higher mortality in fish carrying the larger tag, and no significant difference in mortality in fish carrying the small tag. The study also found a significant relationship between mortality and fish length in the experimental and control groups, concluding that handling alone is likely to cause death in herring smaller than 17cm. The authors suggested that the non-tag induced mortality could be due to lactic acid build-up due to the stress of handling and retention in the laboratory, and advocated tagging and releasing the fish as quickly as possible after capture. Many studies have documented this relationship between lactic acid build-up due to muscular exertion and stress, and mortality (Black, 1957, 1958; Huntsman, 1938; Parker and Black, 1959; Parker et. al., 1959).

All these studies reported a number of contributing factors which confounded analyses, but alluded to some key variables. The method of capture and duration of time between capture and release were generally seen as dominant considerations, and rapid release of the fish back to the wild was important in reducing mortality. Handling was also deemed a mortality factor, such that rapidly applied tags were favoured over those requiring longer handling time.

MATERIAL AND METHODS

I. TAGGING OPERATIONS AND DATA HANDLING PROTOCOLS

Between 1973 and 1982 over 341,000 herring were tagged throughout NAFO Subarea 4 with T-bar anchor tags (Appendices 2.1, 2.2). The fish were captured for tagging by purse seines, weirs and traps. Detailed information of the field operations, data quality, data parameters and format descriptions for the database are provided in Stobo and Fowler (2006).

In the Bay of Fundy area, over 66,000 fish were tagged in the Passamaquoddy Bay-Grand Manan region (statistical area 4Xs), most during the June to December period, between 1973 and 1981. Another 117,000 herring were tagged on the Nova Scotia side of the Bay, from Minas Basin to south of Yarmouth (statistical areas 4Xr,q), during the June to September period, between 1974 and 1979.

Nearly 55,000 herring were tagged along the outer coast of Nova Scotia, between Chedabucto Bay and Cape Sable Island (statistical areas 4Wd,k and 4Xm,o), during the March to August period, between 1976 and 1982. For the coast of Cape Breton, over 31,000 herring were tagged in the vicinity of Chedabucto Bay (statistical area 4Wd), during the 1976 to 1979 winter fishery seasons (October-March). In the Sydney Bight region (statistical area 4Vn) approximately 18,000 herring were tagged during the winter fishery seasons of 1977 through 1980. An additional 2,975 fish were tagged in April-May 1981 at the entrance to the Bras d'Or Lakes in Sydney Bight.

In the Gulf of St. Lawrence, over 56,000 herring were tagged between 1976 and 1981. At the Magdalen Islands (statistical area 4Tf), 9,849 fish were tagged during the 1976 spring spawning fishery (May), and 27,972 fish were tagged in August-September of the same year, during the fall spawning fishery, off the Gaspé-Chaleur Bay region (statistical areas 4Tm,n). An additional 18,298 herring were tagged at Souris, PEI (statistical area 4Tg) in October of 1978 and 1981 to address herring movements associated with that localized fishery.

The tagging methodology has been previously described in Stobo et al. (1976a), but is briefly summarized here. Herring were obtained from weirs and purse seines in the Bay of Fundy area, and from purse seines and traps along the coast of Nova Scotia and in the Gulf of St. Lawrence. Purse seines were the main gear used for the tagging operations in all regions. Purse seiners were used as a tagging platform, both when dedicated to tagging operations and during normal commercial operations. In dedicated tagging operations, the purse seine was partially hauled to concentrate the herring, which were then dip-netted (1-3 per withdrawal) from the seine, immediately tagged and released. During commercial harvesting operations, herring were dip-netted (about 5 per withdrawal) from the seine as it was being hauled, and then released into a tank into which seawater was being constantly pumped. As soon as 100-150 herring were in the tank, they were dip-netted individually, tagged and immediately released. In weir tagging operations, a large semi-submersible (free-flooding) barge was used as the tagging platform. During standard commercial harvesting operations, in which a small purse seine was used to concentrate herring within the weir, herring were dip-netted (about 5 herring per withdrawal) from the purse seine and released into the large free-flooding barge. Up to 500 herring were released into the barge; the barge was then usually towed a short distance away from the weir. The herring were again dip-netted (individually) from the barge, tagged and immediately released. A similar process was used when tagging from traps, or the fish were tagged immediately after being dip-netted from the trap. Emphasis was placed on releasing the herring back to the ocean as quickly as possible. All fish were tagged with T-bar anchor tags applied with a manually operated tagging 'gun' (Dell, 1968).

Recoveries were made primarily by visual detection by herring processing plant personnel. Rewards were paid to the finder, upon submission of the tag accompanied by the required recovery data. The recapture locations were generally descriptive in nature, referring to landmarks known to the local fishermen. When processing the data, scientific staff located the described location on a map superimposed on an electronic screen, with the longitude and latitude coordinates automatically derived by a digitization program. All recovery data were entered into a database, currently maintained as part of a multispecies tagging databased by the Department of Fisheries and Oceans National Science Virtual Data Centre (located under the Maritimes Region, Population Ecology Division, Biological Tagging). The quantity and quality of the recovery information varied to some degree (Appendices 2.3, 2.4). As well, the time at large varied (Appendix 2.5), with almost 66% of the recoveries being made within 3 months of release. Less than 0.3% of the recoveries were from fish that had been at-large for more than 4 years. The mean recovery rate for herring across all studies was 0.04, comparable to that obtained in the earlier studies.

No individual measurements were taken of the tagged herring, rather random samples of about 100 fish per release group were collected from the capture gear and measured, for each purse seine, weir, or trap set (Appendix 2.6). The lengths ranged from 10-42 cm with the smallest fish being caught by the traditional "sardine" fisheries in the Bay of Fundy (statistical areas 4Xr,s) and off southwestern Nova Scotia (statistical area 4Xo). Generally few herring under 18 cm were caught, or tagged, in other areas.

II. WEIGHTING OF HERRING RECOVERIES

At the onset of the tagging program it was known that the recovery of tags would be dependent on commercial fishery operations. The herring fishery was almost solely prosecuted by three gear types during the project period: purse seines, gillnets and weirs (see Miller and Iles, 1975, Stobo et. al., 1982, and Stephenson et al., 1987). While other gear types (eg. shut-off seines) were also employed, and occasionally herring were caught as by-catch in various groundfish fisheries, the catch by these gears were inconsequential to the recoveries of herring tags from the three main gear types.

Three aspects related to commercial fishery tag recoveries that have the potential to distort our impression of movements are the tag detection rate by fishermen or plant workers, the amount of commercial catch and effort directed in the area in which the tag was recovered, and the length of time a fish was at large before it was captured. Previous analyses of segments of the herring tagging projects in the Canadian zone of the northwest Atlantic described in this report did not consider detection rate, catch or effort, and only adjusted for time-at-large by eliminating any recoveries made within 2 weeks of release. Adjustments for each of these factors could improve the information content of the tag recovery data. Unfortunately, insufficient information was collected during the recovery period to assess detection rates, and thus no adjustments were possible for differences in

detection levels at the various plants or on the commercial boats.[1] Also, the information captured by the department's catch/effort system was insufficient to be able to assign comparable measures of effort to the various gear types. Therefore, to adjust the information content of recoveries made across areas and over time, we investigated a relative weighting scheme to standardize recoveries for commercial catch tonnage (as a proxy for effort), and for days-at-large.

To develop a factor for fishing effort, we created a matrix of commercial landings by year, month, and ICNAF unit area (Appendix 3) for 1973-1983, which encompasses the time period in which all our recoveries were made. Dividing the total 4TVWX/5YZ landings for 1974-1982 (tagging began in December 1973 and ended in April 1982, with very few fish recovered in 1983) by the total recoveries gave a crude expectation of one tag per 115.74 metric tons of fishing. While this process does not account for the differences in numbers tagged during the numerous field operations over time, depletions of tagged fish due to fishing and natural mortality, tag loss, or recovery of tagged fish, we felt it would be adequate to demonstrate if weighting for catch had the potential to provide a different impression of herring movements and stock relationships than that provided by plots of the unadjusted tag recoveries. The 115.74 mt/tag expectation was divided into each cell of the catch matrix to produce a rough expected recovery matrix. Finally the expected recoveries for each year-month-area were divided into the observed recoveries.

Use of the commercial landings information necessitates acceptance of the assumption that the landings data were accurate in the amounts reported and in the designation of catch area; that is a difficult assumption to accept since non-reporting of catch and frequent lack-of-reporting of area have been significant features of this fishery. Since the geographic area of catch had been reported only to the level of division, we had to use a variety of pro-rating schemes to attribute landings to unit areas, the smallest geographic area reporting units recorded in the commercial catch database, and the largest size of units that we felt were still adequate for stock movement description. We had intended to use these values as catch-weighted recoveries, but the range of the adjusted values was unreasonable, even considering the approximate nature of the method. Very high values were obtained for areas that were consistently poorly represented as commercial catch locations due to reporting habits rather than true effort levels. The extent of this problem was beyond the capability of the pro-ration process to resolve using existing landings data. As a fallback we treated the values obtained as orders of magnitude, producing a weighting factor of 1 to 5 according to the number of digits of the values. We were thus only able to develop a relative weighting for tags, not a standardized adjustment as originally hoped.

To develop a factor for days-at-large, we treated the mean time-at-large for all recoveries (120 days, when rounded to a whole number), as a threshold point between

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[1] We know from recent tagging studies of herring in Scots Bay and on German Bank that reporting rates can vary considerably between processing plants, with some major herring processing plants never reporting tags while others report tags consistently. (Clark, K.J. 2006. An examination of turnover rates of herring on the spawning grounds of Scots Bay and German Bank using tagging data. CSAS Res. Doc. 2006/46).

recoveries that should have more or less influence. Dividing the days-at-large for each tag by 120 created a continuum from 0 to over 18. However we made 7 (840 days) the maximum weight factor, as beyond this point we saw some instances of multiple recoveries, and preferred not to risk the possibility of erroneous weighting due to hoarded tags. Some individuals would collect tags for extended periods, such as many years, before they (or surviving relatives) turned them in, and the location and timing of the original recapture events could be dubious.

Results for weighting recoveries by either days-at-large, or the combination of both days-at-large and landings factors adjustments, did not suggest any interpretive divergences from the raw recovery plots. It may be that the volume of recoveries is sufficient of itself to portray movements using monthly plots. We decided therefore not to use any catch-weighted adjustments in the analyses. The days-at-large adjustment facilitated use of all recovery data collected, without over-emphasizing short-term recoveries, so we incorporated that adjustment into the analyses.

III. INTERPRETATION

We initially addressed each tagging study by itself, using the results to identify redundancies in geographical and temporal tag-recovery patterns between studies. Compatible studies were then combined into 15 geographic tagging areas that we felt sufficient to distinguish movements among potentially discrete populations. Table 1 outlines how the studies were grouped, and indicates whether adults or juveniles (or both) were tagged. Figure 1 compliments this table with a visual depiction of the tagging area groups.

Location and timing of spawning, relative to tagging, is essential to interpreting the movements of herring. The perceived spawning grounds of the major herring populations during the 1973-1983 time period are presented in Figure 2. This figure combines depictions of spawning grounds from Leblanc et al (2007), Overholtz et al (2004), and Stobo et al (1982). There are many more known, and probably unknown, spawning grounds, especially along coasts. These are regarded as associated with minor local stocks of herring (e.g. Sydney Bight, Chedabucto Bay, and a number of bays along the southern coast of mainland Nova Scotia). That perception may have altered in recent times, as previously dominant populations have diminished and new spawning components have supplanted them in importance. There also is or was a discrete Banquereau herring population, fished out prior to the tagging studies discussed here (fishing did not resume again until the mid-1990's), which was believed to have originated from local spawning.

Also critical to interpretations of tag recoveries are the timing and locations of herring fisheries. As mentioned, attempts to quantify fishing effort did not improve our depictions of herring movements. However, the simple presence/absence of the main fisheries in time and space affects the interpretation greatly. The locations, nature, and seasonal focus of the major herring fisheries from 1973 to 1983 are shown in Figure 3, with more detailed descriptions provided in Table 2. This information was compiled from

several herring resource assessments (Leblanc et al, 2007; Overholtz et al, 2004; Simon and Stobo, 1983; Sinclair et al, 1979; Sinclair et al, 1980; Sinclair et al, 1981; Stobo, 1977; Stobo and Simon, 1982; Stobo et al, 1982). Table 2 notes the life history stages being fished, and identifies some historical events that would alter or obstruct likelihoods of tag recoveries in certain areas at certain times.

Combining our knowledge of the timing and location of spawning, the fisheries, and the tagging studies allowed us to describe a coherent picture of the identity and movements of the various herring populations throughout the Gulf of Maine, Bay of Fundy, Nova Scotian Shelf, and Gulf of St Lawrence.

RESULTS & DISCUSSION

Much of our perception of the stocks and movements of herring associated with the Bay of Fundy, Scotian Shelf and Gulf of St Lawrence were derived from a stock discrimination symposium conducted by NAFO in the early 1980's. Much of the data represented in this study was used to inform the deliberations of the working group at the symposium (Stobo, 1982; Stobo, 1983). There have, however, been some new insights derived from these data since the symposium. These include:

1. Previously unconsidered tagging studies in St Mary's Bay, St Annes Bay, and the Gulf of St Lawrence.
2. New recoveries, largely from herring tagged during 1981-1982, that had either not occurred or didn't get processed in time for the symposium.
3. Finer-scale splitting by month and release area, as opposed to season and relatively broad herring management areas.
4. Breaking out juveniles precisely wherever possible, avoiding some earlier assumptions concerning the predominant makeup of juvenile/adult mixtures.
5. Weighting by days at large.

Table 3 summarizes the weighted recoveries for releases that included adult herring. We have found this table useful to gauge relative proportions of recoveries from different regions.

GRAND MANAN

The herring tagged off Grand Manan as adults or adult/juvenile mixtures spent their summers feeding throughout the area of the Bay of Fundy (Fig. 4a). During the winter months they either remained in the Bay of Fundy, moved west into the Gulf of Maine (especially the Jeffrey Ledge area), or east to Chedabucto Bay. Such diverse and long-range movements indicate that a mixture of local and migrant populations cohabit the Bay of Fundy in summer.

Juveniles from these tagging studies (tagged in June 1974) showed much less variability in their movements than the groups including adults, and may represent a single population that feeds in the Bay of Fundy during summer and overwinters in Chedabucto Bay (Fig. 4b). None appeared to overwinter either in the Gulf of Maine or locally in the Bay of Fundy.

ENTRANCES TO PASSAMAQUODDY BAY

The fish tagged indeterminately as a mix of adults and juveniles, during July and August spent their summers ranging widely throughout the Bay of Fundy and Gulf of Maine (Fig. 5a). In winter, similar to the Grand Manan herring, they remained locally or migrated either west (Jeffrey Ledge) or east (Chedabucto Bay), indicating mixing of herring in the Bay of Fundy during summer feeding. Some fish turned up in Sydney Bight during summer/fall months, which may evidence some degree of crossing over between different populations when mixed.

Juveniles tagged during the summer mostly remained in the Bay of Fundy over winter months (Fig. 5b). Returns from overwintering areas to the east or west are too few to discern if different populations were tagged, as opposed to crossing over between populations during summer feeding. Consequently the returns fail to inform on the relative proportions of these populations.

The juveniles tagged during the winter never strayed far from the tagging area at any time, and this is reinforced by the existence of recoveries in every month (Fig. 5c) The sustained overwintering presence of juveniles in the Bay of Fundy does not, however, provide any discrete information on stock origin .

PASSAMAQUODDY BAY

Herring tagged inside Passamaquoddy Bay tended to remain in or near the Bay of Fundy throughout the year (Fig. 6a). The large number of recoveries across all months emphasizes the local nature of these herring. Most of the fish tagged were juveniles (Fig. 6b), so there are no relevant differences between Figures 6a and 6b.

SCOTS BAY

The recoveries from spawning or pre-spawning herring tagged near Scots Bay at the head of the Bay of Fundy raise more questions than they answer. It was believed that these were a local population that spawned in the tagging area. However, while the timing of the tagging operations was planned to coincide with the Scots Bay spawning period, it is unknown to what extent pre-spawning herring from other spawning areas may also have been tagged. The overwintering tag recoveries (Fig. 7) from both east (Gulf of Maine) and west (Chedabucto Bay) suggest that the tagged herring were a mix of fish that included one or both of the large late-summer and fall-spawning components of the Gulf of Maine and southwest Nova Scotia populations. The lack of any significant historical adult over-wintering fishery in the Bay of Fundy indicates that all the tagged herring

overwintered outside the Bay of Fundy, either Chedabucto Bay or the Gulf of Maine. But due to the presence of pre-spawning herring in the tagged group, and the low numbers of winter returns, we cannot discern if either of the Gulf of Maine or southwest Nova Scotia populations are associated with the Scots Bay spawning component. Note that two recoveries (four weighted) in March from the Gulf of Maine (see Table 3) are from Naragansett Bay (Rhode Island), and are not shown in Figure 7.

ANNAPOLIS BASIN TO MORDEN

Herring tagged during July (1978 and 1980) between Annapolis Basin and Morden, along the Nova Scotian coast of the inner Bay of Fundy, summered throughout the Bay of Fundy and eastern Gulf of Maine area (Fig. 8a). In winter most migrated east to Chedabucto Bay/Sydney Bight. A few January-March recoveries from the western Gulf of Maine could reflect mixing during tagging or subsequent crossing over between schools of herring.

Most of the juveniles tagged at the entrance to Annapolis Basin in July were recovered throughout the year, in the general vicinity of the Bay of Fundy throughout most months of the year (Fig. 8b).

SOUTHWEST NOVA SCOTIA (DIGBY NECK TO TRINITY LEDGE)

The adult herring tagged during June-September (1974 and 1977) off southwest Nova Scotia summered throughout the Bay of Fundy and Gulf of Maine area (Fig. 9). The majority then migrated to Chedabucto Bay/Sydney Bight for the winter, but many also went west to the Jeffrey Ledge area in the Gulf of Maine. The large numbers tagged and recovered suggest a 3:1 ratio of easterly versus westerly migrants. While the overall ratio was 3:1, it is notable that the 1974 tagging operations encountered many more pre-spawning herring (ie. tagging preceded the major spawning period) than did the 1977 tagging operations. The proportion of overwintering recoveries from the Chedabucto Bay/Sydney Bight area versus the Gulf of Maine area was much higher from the 1977 releases (1974: 52.6% vs 47.4%; 1977: 87.2% vs 12.8%) (see Stobo 1974; 1975), suggesting a higher eastward overwintering migration of the component spawning off southwest Nova Scotia. However, it is not known if the tagging sampled the populations in the area proportionately to their abundance.

ST MARYS BAY

All the juvenile herring tagged during June (1979) in St Marys Bay were recovered in or near the Bay of Fundy (Fig. 10). We see these fish shift from the Nova Scotian side of the Bay of Fundy to the New Brunswick side during the fall, and none were recovered south of Cape St Marys at any time. The absence of winter recoveries suggests they did not migrate to either of the Gulf of Maine or Cape Breton areas that support overwintering fisheries. There was no documented juvenile herring fishery in the St. Mary's Bay area in

February-March of 1980. However, the juvenile fishery in that area did occur in January of that year, when one would have expected recoveries from juveniles tagged there in the previous summer, but none were reported. While they may have remained locally, or elsewhere in the Bay of Fundy during the winter, at a location not unknown to the fishing industry, they may also have overwintered somewhere outside the Bay of Fundy not subject to fishing.

WESTERN HEAD TO ST MARGARETS BAY

The herring tagged in these areas along the south shore of Nova Scotia in the spring, dispersed widely throughout the Bay of Fundy area during the summer, and overwintered in the east (Chedabucto Bay/Sydney Bight; Fig. 11a). The few Gulf of Maine recoveries were near the coast of Maine, and are likely associated with feeding dispersal. There does not appear to be a westerly overwintering component. The only recoveries from the actual tagging area occurred during spring months, which is when they were tagged. While there are reports of local populations in the area, these results suggest the fish were tagged during the spring migration (March-April) from the overwintering area off Cape Breton to the summer feeding grounds in and around the Bay of Fundy.

There were a lot of juveniles in this group of tagged fish, and they showed a similar pattern of movement as the adults (Fig. 11b). The recoveries do not indicate a tendency to remain local to the tagging area for either feeding or overwintering.

CHEDABUCTO BAY

Winter tagging of herring in Chedabucto Bay demonstrates the largely western origin of these fish, most feeding in the Bay of Fundy area during the summer (Fig. 12a). Enough of these herring were recovered from the tagging area in subsequent summers to establish the existence of a resident local population in Chedabucto Bay. There were also enough returns from the Gulf of St Lawrence throughout spring/summer/fall months to indicate that Chedabucto Bay is also an overwintering area for a component of the Gulf of St Lawrence fall-spawning group. Unfortunately, recoveries of juveniles, tagged in Chedabucto Bay in the winter, were too few (3) and too dispersed (Bay of Fundy, Gulf of St Lawrence, and Chedabucto Bay) to make inferences (Fig. 12b) about movements or population associations. The April-May tagging of adults in Chedabucto Bay was intended to target the resident population. Summer recoveries from both the Bay of Fundy area and Chedabucto Bay suggest a mix of fish were tagged (Fig. 13). Possibly the timing of tagging was too early, and overwintering fish from the west were still present. The western migrants tended to remain in Nova Scotian waters, few crossing the Bay of Fundy to the New Brunswick side, and none reaching the Gulf of Maine. There were two tags reported as being recovered in January-February of 1980 from this release group, but that recovery date was prior to the conduct of the tagging operation. They are shown in Figure 13 as zero-weight (+) recoveries and most likely are an example of hoarded tags.

SYDNEY BIGHT – EAST OF ST ANNES BAY (East SAB)

Adult herring tagged in winter to the east of St Annes Bay in Sydney Bight appear to be a mix of western (Bay of Fundy, southwest Nova Scotia) and Gulf of St Lawrence fish (Fig. 14), with the western fish slightly dominant in numbers (Table 3). The western migration did not extend across the Bay of Fundy, but a number of these fish were taken in the Scots Bay fishery.

SYDNEY BIGHT – NORTH OF ST ANNES BAY (North SAB)

Adult herring tagged in winter to the north of St Annes Bay in Sydney Bight were, like the herring discussed in the preceding subsection, a mix of western and Gulf of St Lawrence fish (Fig. 15). However, the Gulf of St Lawrence component predominated for this group, with returns from all the major (spring and fall) fisheries in the Gulf. Western migrants did not cross the Bay of Fundy or enter the Gulf of Maine.

SYDNEY BIGHT – ST ANNES BAY

Adult herring were tagged in spring within St Annes Bay, between the eastern and northern tagging groups discussed previously, because it was believed by local fishermen that there was a local population in this area. While recoveries from the spring Edge/Magdalens and Northumberland Strait fisheries suggest that they may instead have been Gulf of St Lawrence fish that had not yet returned for the summer (Fig. 16), the lack of a spring/summer fishery within Sydney Bight would make it difficult for a resident population to be demonstrated. Most of the recoveries were made from the overwintering fisheries in Sydney Bight and Chedabucto Bay. The general paucity of returns from other fisheries leaves the identity of these fish in doubt.

MAGDALEN ISLANDS

Spring-tagging of adult herring near the Magdalen Islands produced returns mostly from the spring Magdalens and Edge fisheries (Fig. 17). There were no recoveries during July-September, but this result is not unexpected since there are only limited summer herring fisheries in the Gulf of St Lawrence. During the fall a few recoveries were reported from the Chaleur Bay area, and during the winter from Chedabucto Bay (a TAC closure would have negated the possibility of returns from Sydney Bight in January of 1976).

SOURIS

The herring tagged off Souris, Prince Edward Island, were adults, and tagged in the fall when there were only minor fisheries in the Northumberland Strait area.

Recoveries from these fish (Fig.18) were most prominent during the winter , in Sydney Bight and Chedabucto Bay. In spring recoveries were made in the Edge (of the Laurentian Channel), Magdalens and eastern Northumberland Strait fisheries. No recoveries in the Gulf of St Lawrence occurred during June-August, but fishing effort is limited in the Gulf area during this period of the year. Notably no recoveries were reported from the fall Chaleur Bay fishery, which reinforces the hypothesis that the tagged herring were a southern Northumberland Strait fall-spawning group.

Summer/fall recoveries off southwest Nova Scotia feature as strongly as Gulf of St Lawrence recoveries during the same period. This is a consequence of weighting, as these were two tags adjusted due to the days-at-large weighting procedure to 3 and 5 tags. A concern in this case was the practice of sometimes landing southern Northumberland Strait herring at nearby ports in Nova Scotia rather than Prince Edward Island, for trucking to southwest Nova Scotia processing plants, where the tags were commonly discovered. This likely occurred during the summer-fall period of lower fishing effort on Northumberland Strait herring, when local plants shut down or focused on groundfish, while plants in southwest Nova Scotia were focused on the large summer/fall herring fishery off their own coast. Processing staff sometimes made local assumptions about the origins of a batch of fish, and this might account for the apparent southwest Nova Scotia recoveries. Crossing over between schools during winter in Sydney Bight-Chedabucto Bay is also a possibility, but the proportion is high relative to the other tagging studies where this was observed.

CHALEUR BAY

The Chaleur Bay fall tagging operation targeted juveniles, but about 10% of the fish tagged were spawning adults. Recoveries were reported from every major Gulf of St Lawrence fishery except the easternmost Northumberland Strait spring fisheries (Fig. 19). A clear pattern of overwintering outside the Gulf is evident from the November-January recoveries from Sydney Bight and Chedabucto Bay. The spring return to the Gulf is shown in recoveries in the spring fisheries at the Edge (of the Laurentian Channel) and Magdalen Islands beginning in April, with large numbers of recoveries from Chaleur Bay starting in May and continuing through the summer and fall. Considering the large numbers of tags recovered from this area and the total absence of recoveries from the southern and eastern Northumberland Strait fisheries, it seems that these fish enter and leave the Gulf crossing north of Prince Edward Island.

The comparatively low number of returns from the major Sydney Bight and Chedabucto Bay fisheries relative to the subsequent, smaller spring fishery in Chaleur Bay, might indicate that many of these herring overwinter in the Laurentian Channel where there is no fishery. Strong winter (Nov-Dec) herring fisheries across the Channel in 4Rd, considered an historical overwintering area for Gulf herring (Claytor, 2001), demonstrated no returns of these fish. Possibly confusing the picture, 1976 (the tagging year) was noted as a bad year for trying to fish Sydney Bight due to weather problems. In fact, virtually all the November-December recoveries from Sydney Bight occurred in 1977 or later years. It was also very common for the purse seine fleet to depart Sydney Bight for Chedabucto Bay in January, as much greater concentrations of herring were typically

found in Chedabucto Bay in January. If the Chaleur herring tagged in 1976 associated more with the Channel area (and/or Sydney Bight), they would be less available to the overwintering fisheries of the time.

Returns from southwest Nova Scotia and the Bay of Fundy appear plausible, and could reflect some exchange between overwintering schools of Chaleur Bay and southwest Nova Scotia herring.

CONCLUSIONS

Although adults tagged in the Bay of Fundy demonstrate that the area is a major summer feeding ground for populations of herring that overwinter in the western Gulf of Maine and waters around Cape Breton, juveniles tagged in the Bay of Fundy were infrequently recovered from the Gulf of Maine. Most juveniles either remained near the area tagged or migrated east to Chedabucto Bay to overwinter. This does not reflect the current perception (Power et al, 2007) that the juvenile herring fishery in the general vicinity of Grand Manan and Passamaquoddy Bay, today termed the 'Southwest New Brunswick migrant juveniles' stock management component, is dominated by herring derived from the Gulf of Maine spawning component. Given the mobility, schooling behavior, and shared feeding grounds of herring populations, the potential for systematic trends in crossover between populations may be quite high. However given the tagging results, it might be warranted to reconsider the decision to totally exclude the new Brunswick catches from the assessment of the south-western Nova Scotia stock.

The juvenile herring tagged in the vicinity of Passamaquoddy Bay in the Bay of Fundy, provide our only clear example of juveniles remaining local to their nursery area throughout the year. For all other cases of juvenile tagging with substantial winter recoveries (eg. Grand Manan, Scotian Shelf (Western Head) and Chaleur Bay), juveniles migrated appreciably for both summer feeding and overwintering. Some cases of pronounced movements for Chaleur Bay herring may have been adults, or juveniles near maturity, but likely not in numbers sufficient to confound patterns of movement.

Earlier work (Stobo, 1982; Stobo,1983), conducted after the tagging operations were completed, but before all the recoveries were obtained and processed, may have over-emphasized Gulf of Maine recoveries relative to Cape Breton recoveries with respect to tagging on the New Brunswick side of the Bay of Fundy. Continued returns since the herring data was last investigated altered this perception, as did weighting for days at large. It might be more appropriate to recognize that juvenile herring in the Bay of Fundy originate primarily from the Bay of Fundy, and these juveniles generally stay in that area over-winter, or undergo an over-wintering migration eastward; and secondly, that the Bay of Fundy is a summer mixing area for adult herring from both the Gulf of Maine and Bay of Fundy/Scotian Shelf areas. While the current examination does not allow determination of stock components, the data do suggest a significantly greater tendency for eastern migration of adults to over-wintering grounds. The difference in the proportions migrating eastward versus westward between the 1974 and 1977 tagging

operations is notable and implies potential for strong year-to-year variation in exploitation of stock components during the summer mobile fisheries in the Bay of Fundy.

The current notion that Gulf of St Lawrence herring overwinter in 4Vn (LeBlanc et al, 2007; Claytor, 2001) and (historically) in 4Rd in the vicinity of Cape Anguille, Newfoundland (Claytor, 2001) might assume greater proximity to the Gulf during the overwintering period than actually occurs. Recoveries of all Gulf tagging groups from the now-defunct herring fishery in Chedabucto Bay, in 4Wd between Cape Breton and Nova Scotia, featured strongly. During the last several years there has been little or no winter mobile fishery in the general Chedabucto Bay area, and it has been suggested that herring no longer over-winter there. Given the mobility and temperature preferences of herring, a change of such magnitude is possible, but would require a significant evolution of the migratory process. The demise of that over-wintering fishery might also be the result of a combination of factors: a minor shift in the overwintering distribution in the 4W area (since such shifts have been observed in this area over the history of the fishery (see Stobo, 1974, 1975)), coupled with a decrease in the annual herring TAC. The reduced individual boat allocations would result in less need for the boats to find over-wintering herring, and fewer boats searching for the over-wintering concentrations would make it much more difficult to locate commercial concentrations of herring.

The waters around Cape Breton served as the overwintering grounds for all juvenile tagging groups, from Grand Manan in the Bay of Fundy to Chaleur Bay in the Gulf of St Lawrence, that undertake over-wintering migrations. This consistency may lend weight to conjectures of other over-wintering grounds, not being fished, to account for the lack of winter returns, either distant or local, from some groups, such as those tagged in Chaleur Bay (and possibly St Marys Bay). Perhaps this amounts to nothing more than juveniles staying a little more offshore in the Laurentian Channel than other herring groups, which would make them unavailable to the fisheries of the time. Alternatively they might overwinter somewhere offshore that we have not identified, due to lack of fishing effort in those areas.

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Table 1. Summary of tagging studies discussed in this paper. Details of group membership, maturity, and a lookup key to associated figures are provided.

Year	Month	NAFO Area	Group Name	Composition	Figures	Number Released	Number Recovered	Percent Recovered
1973	Nov	4XS	Grand Manan	mixed	4a	2432	16	0.7
1973	Dec	4XS	Grand Manan	mixed	4a	8777	184	2.1
1978	Aug	4XS	Grand Manan	adults	4a	2375	121	5.1
1979	Sep	4XS	Grand Manan	adults	4a	2900	70	2.4
1979	Oct	4XS	Grand Manan	adults	4a	2025	43	2.1
1974	Jun	4XS	Grand Manan	juveniles	4b	3860	213	5.5
1974	Jul	4XS	Passamaquoddy Bay Entrances	mixed	5a	5960	541	9.1
1977	Jul	4XS	Passamaquoddy Bay Entrances	mixed	5a	6541	525	8.0
1977	Aug	4XS	Passamaquoddy Bay Entrances	mixed	5a	4871	1043	21.4
1974	Jul	4XS	Passamaquoddy Bay Entrances	juveniles	5b	2173	73	3.4
1977	Aug	4XS	Passamaquoddy Bay Entrances	juveniles	5b	3049	653	21.4
1973	Nov	4XS	Passamaquoddy Bay Entrances	juveniles	5c	938	97	10.3
1978	Feb	4XS	Passamaquoddy Bay	-	6a	50	3	6.0
1978	Mar	4XS	Passamaquoddy Bay	-	6a	3949	32	0.8
1977	Aug	4XS	Passamaquoddy Bay	juveniles	6b	7974	1606	20.1
1981	Sep	4XS	Passamaquoddy Bay	juveniles	6b	9290	484	5.2
1980	Jul	4XS	Scots Bay	adults	7	3309	397	12.0
1981	Jul	4XR	Scots Bay	adults	7	9515	144	1.5
1978	Jul	4XR	Annapolis	mixed	8a	2880	142	4.9
1980	Jul	4XR	Annapolis	adults	8a	1025	40	3.9
1980	Jul	4XS	Annapolis	mixed	8a	399	20	5.0
1978	Jul	4XR	Annapolis	juveniles	8b	12217	194	1.6
1974	Aug	4XQ	SW Nova Scotia	adults	9	5978	91	1.5
1974	Aug	4XR	SW Nova Scotia	adults	9	17960	357	2.0
1977	Jun	4XQ	SW Nova Scotia	adults	9	254	15	5.9
1977	Aug	4XO	SW Nova Scotia	adults	9	15984	512	3.2
1977	Aug	4XR	SW Nova Scotia	adults	9	7917	173	2.2
1977	Sep	4XO	SW Nova Scotia	adults	9	12321	391	3.2
1977	Sep	4XQ	SW Nova Scotia	adults	9	11044	298	2.7
1977	Sep	4XR	SW Nova Scotia	adults	9	7000	127	1.8
1979	Jun	4XR	St Marys Bay	juveniles	10	9092	618	6.8
1980	Apr	4XM	Western Head	adults	11a	3639	19	0.5
1980	Jun	4XO	Western Head	adults	11a	10036	136	1.4
1978	Apr	4XO	Western Head	juveniles	11b	9991	4	0.0
1979	Mar	4XO	Western Head	juveniles	11b	10325	93	0.9
1976	Jan	4WD	Chedabucto Bay	mixed	12a	3000	2	0.1
1977	Jan	4WD	Chedabucto Bay	adults	12a	1025	46	4.5
1978	Jan	4WD	Chedabucto Bay	adults	12a	4795	607	12.7
1978	Nov	4WD	Chedabucto Bay	adults	12a	364	33	9.1
1978	Dec	4WD	Chedabucto Bay	adults	12a	3364	288	8.6
1979	Jan	4WD	Chedabucto Bay	adults	12a	299	25	8.4
1976	Feb	4WD	Chedabucto Bay	juveniles	12b	12692	3	0.0
1980	May	4WD	Chedabucto Bay	adults	13	7286	132	1.8
1982	Apr	4WD	Chedabucto Bay	adults	13	7117	17	0.2
1977	Nov	4VN	Eastern Bight	adults	14	588	36	6.1
1977	Dec	4VN	Eastern Bight	adults	14	2494	117	4.7
1978	Nov	4VN	Eastern Bight	adults	14	2106	100	4.8
1978	Nov	4VN	Northern Bight	adults	15	1072	69	6.4
1978	Dec	4VN	Northern Bight	adults	15	816	35	4.3
1979	Dec	4VN	Northern Bight	adults	15	4554	504	11.1
1980	Jan	4VN	Northern Bight	adults	15	6151	577	9.4
1981	Apr	4VN	St Annes Bay	adults	16	2225	37	1.7
1981	May	4VN	St Annes Bay	adults	16	750	4	0.5
1976	May	4TF	Magdalen Islands	adults	17	9849	237	2.4
1978	Oct	4TG	Souris	adults	18	8000	92	1.2
1981	Oct	4TG	Souris	adults	18	10298	32	0.3
1976	Aug	4TN	Chaleur Bay	mostly juveniles	19	10822	340	3.1
1976	Sep	4TM	Chaleur Bay	mostly juveniles	19	8501	453	5.3
1976	Sep	4TN	Chaleur Bay	mostly juveniles	19	8649	545	6.3

Table 2. Summary of major herring fisheries during the 1973-1983 period on which we relied for tag returns.

Fishery	Description	Tag Recovery Caveats
Georges Bank	Summer-fall spawning grounds seine fishery on adults.	Fishery collapsed in 1976. Would not expect recoveries from tagging studies after 1976.
Gulf of Maine	Coastal/nearshore fall spawning grounds seine and fixed gear fisheries on adults mostly from Jeffrey Ledge to Cape Ann.	
Maine juvenile	Nearshore fall spawning grounds seine fishery on juveniles mostly from Jeffrey Ledge to Cape Ann.	
New Brunswick seine	Fall fishery on juveniles and adults from Grand Manan to St John on the New Brunswick side of the Bay of Fundy.	
New Brunswick fixed gear	Fall fishery on juveniles and adults in and around Passamaquoddy Bay.	
SW Nova seine	Southwest Nova Scotia summer meal fishery on juveniles until 1978 (meal market lost), then a summer/fall fishery on feeding or spawning adults.	
SW Nova fixed gear	Southwest Nova Scotia summer fishery on spawning adults.	
Chedabucto Bay	Winter seine fishery on overwintering juveniles and adults.	
Sydney Bight	Winter seine fishery on overwintering adults.	TAC closures negate possibility of January recoveries in 1979, 1982 and 1983. Bad weather may have negated recovery likelihood in January, 1976.
Edge	Spring seine fishery in the Gulf of St Lawrence along the Laurentian Channel and coast of Cape Breton.	A low overall mobile fleet TAC would mitigate against recoveries in 1981.
Magdalen Islands	Spring coastal fixed gear fishery on spawners.	
North PEI	Spring seine fishery on pre-spawning migrants.	A low overall mobile fleet TAC would mitigate against recoveries in 1981.
Northumberland Strait	Spring fixed gear fishery on spawners.	
Chaleur Bay fixed gear	Fall fixed gear fishery on spawners.	
Chaleur Bay seine	Fall seine fishery on spawners.	A low overall mobile fleet TAC would mitigate against recoveries in 1981.

Table 3. Weighted recoveries (rounded) by month and general area for major releases.

RELEASE GROUP		Gulf of Maine	Bay of Fundy, New Brunswick side	Bay of Fundy, Nova Scotia side	Southwest Nova Scotia	Chedabucto Bay, Sydney Bight	Gulf of St Lawrence
Grand Manan	January	11	42			4	
	February	1	15				
	March	8	4				
	April	2	23	2		9	
	May	4	12	10			
	June	2	11	37	10		
	July	8	24	30	16		
	August	0	88	36	3		
	September		110	36			
	October	1	137		0	1	
	November	2	36		1		
	December	1	22			8	
Passamaquoddy Bay Entrances	January	46	34		1	48	
	February	83	29				
	March	97	14		8		
	April	2	6		5		
	May	3	12	5	3		
	June	14	8	30		12	
	July	29	67	47	6	0	
	August	20	261	42	48	0	0
	September	13	225	6	25	1	
	October	9	100	1	4		
	November	15	70			1	
	December	1	23				
Passamaquoddy Bay	January	4	118			3	
	February		156		2		
	March		191		7		
	April		24		8		
	May		56				
	June	5	74	24			
	July	5	103	20	5		
	August		150	6			
	September	6	256	9	19		
	October		202				
	November	1	135				
	December		29				

Table 3 (con't). Weighted recoveries (rounded) by month and general area for major releases

RELEASE GROUP		Gulf of Maine	Bay of Fundy, New Brunswick side	Bay of Fundy, Nova Scotia side	Southwest Nova Scotia	Chedabucto Bay, Sydney Bight	Gulf of St Lawrence
Scots Bay	January	2	2			2	
	February	2					
	March	4					
	April						
	May						
	June				3		
	July		15	49	12		
	August		1	9	1		
	September		9	4	1		
	October		27	2	1		
	November		7				
	December					6	
Annapolis Basin to Morden	January	2	4	1		24	
	February	2	5				
	March	2					
	April				4		
	May		2	5			
	June		3	19		3	
	July		24	79	9		
	August	3	9	25	1	0	
	September		15	1	7		
	October		7	1	1		
	November		7	1			
	December		5			16	
Southwest Nova Scotia	January	3	4			231	1
	February	3	10			9	
	March	29					
	April	45					10
	May			14	2	8	5
	June	5	26	174	32	5	
	July	5	48	104	159	8	
	August	21	108	36	67		
	September	7	43	49	110	0	
	October	1	34	12	22		4
	November	11	10		1	4	
	December	5	18			48	

Table 3 (con't). Weighted recoveries (rounded) by month and general area for major releases

RELEASE GROUP		Gulf of Maine	Bay of Fundy, New Brunswick side	Bay of Fundy, Nova Scotia side	Southwest Nova Scotia	Chedabucto Bay, Sydney Bight	Gulf of St Lawrence
Western Head to St Margarets Bay	January						
	February					14	
	March					3	
	April				0		
	May				2		
	June			4	2		
	July		4	18	1		
	August		6	13	5		
	September	1	20	4	2		
	October		13				
	November		2				
	December	2				8	
Chedabucto Bay (winter)	January	3		0		4	
	February					230	
	March	4				9	13
	April					7	
	May		1		1	1	11
	June				16	26	7
	July		5	26	35	3	
	August		10	120	101	14	
	September		12	39	83		4
	October	5	4	8	23		2
	November		10	10	10		
	December		2			5	7
			3			3	
						34	
Chedabucto Bay (spring)	January						
	February					0	
	March					0	
	April						
	May						
	June					21	
	July				9	8	
	August		1	13	11	13	
	September			3	4		
	October		4	19			1
	November			5			
	December				3		
						3	
						2	

Table 3 (con't). Weighted recoveries (rounded) by month and general area for major releases

RELEASE GROUP		Gulf of Maine	Bay of Fundy, New Brunswick side	Bay of Fundy, Nova Scotia side	Southwest Nova Scotia	Chedabucto Bay, Sydney Bight	Gulf of St Lawrence
Sydney Bight (East SAB)	January					161	
	February					12	
	March						14
	April					5	6
	May				3	3	
	June			7	15		
	July			2	12		
	August						
	September						
	October					30	
	November					34	
	December						
Sydney Bight (North SAB)	January					175	
	February					16	
	March						20
	April					4	21
	May					29	10
	June				9	3	3
	July			9	7		21
	August				5		24
	September				2		13
	October						11
	November					90	3
	December					116	
Sydney Bight St Annes Bay	January						
	February						
	March					3	
	April					19	3
	May					1	4
	June						
	July						1
	August						
	September					4	
	October					33	
	November					5	
	December						

Table 3 (con't). Weighted recoveries (rounded) by month and general area for major releases

RELEASE GROUP		Gulf of Maine	Bay of Fundy, New Brunswick side	Bay of Fundy, Nova Scotia side	Southwest Nova Scotia	Chedabucto Bay, Sydney Bight	Gulf of St Lawrence
Magdalen Islands	January					11	
	February						
	March						
	April						35
	May					3	35
	June						9
	July						
	August						
	September						
	October						1
	November						5
	December						
Souris, PEI	January					4	
	February					5	
	March						
	April					1	2
	May						5
	June						
	July						
	August				5		
	September						3
	October			3			0
	November					4	0
	December					15	0
Chaleur Bay	January					8	4
	February		8				
	March						
	April					11	38
	May						797
	June			17			46
	July		3				48
	August				21		50
	September						184
	October						388
	November					7	1097
	December					32	92

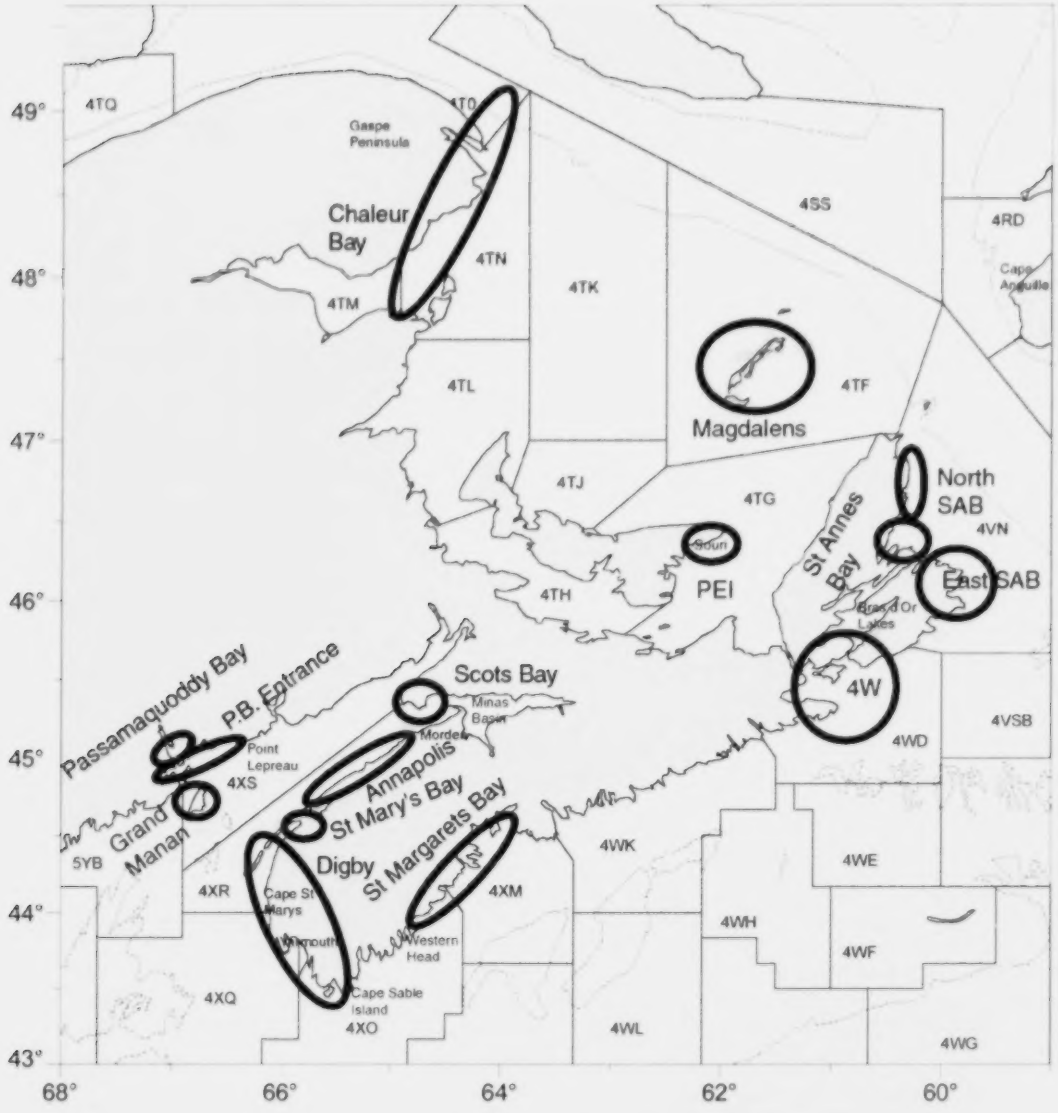


Figure 1. Generalized areas into which discrete herring tagging releases were grouped for this analysis. The details of the discrete tagging studies in these groups are given in Table 1. The map also depicts the NAFO unit areas often referred to in the text, and the 200m depth contours (dashed lines).

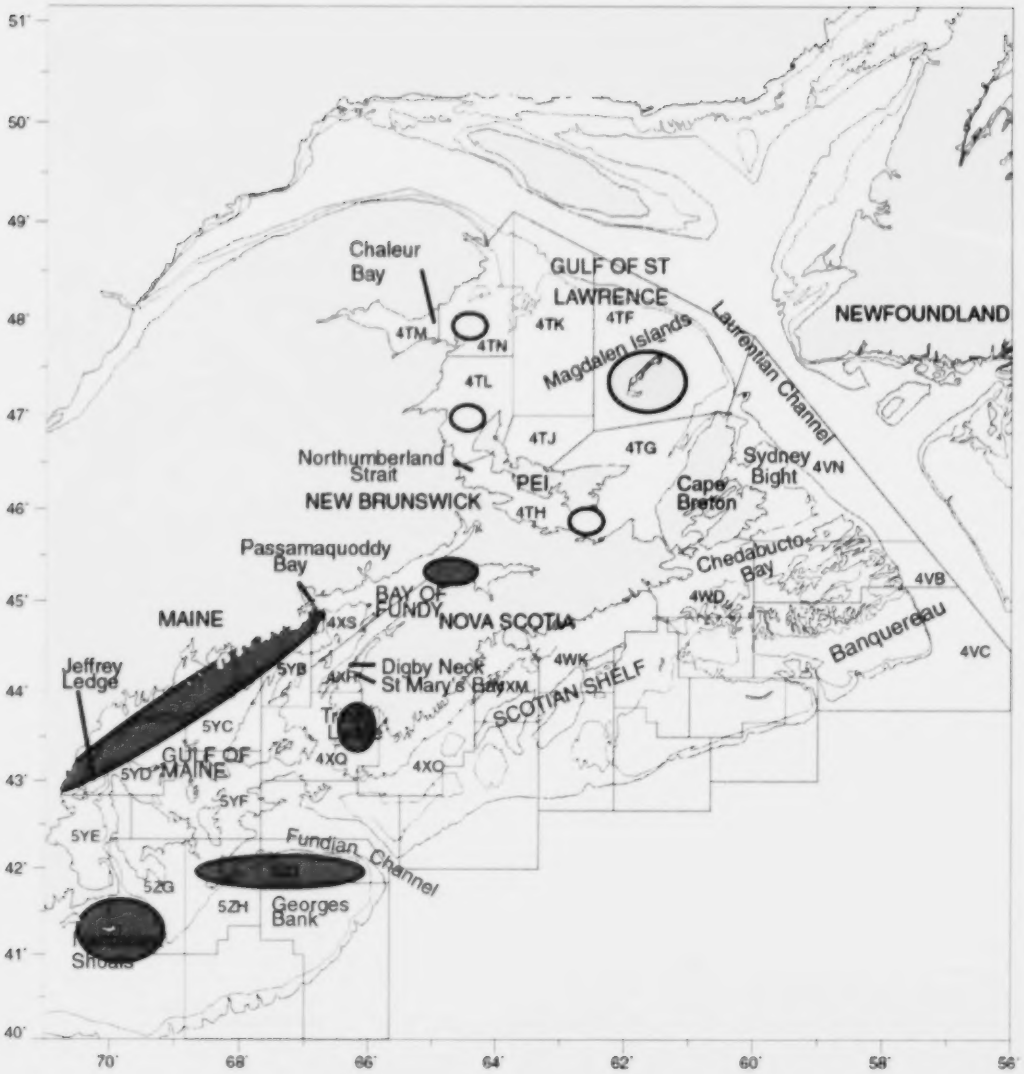


Figure 2. Locations of major herring spawning grounds. Spawning season is indicated by colour as fall (red), spring (green), or both spring and fall (yellow). Common names of geographic features and the boundaries of DFO Statistical Unit Areas mentioned in the text are provided. The 100-meter (blue) and 200-meter (black) contour lines are used to distinguish major depth breaks.

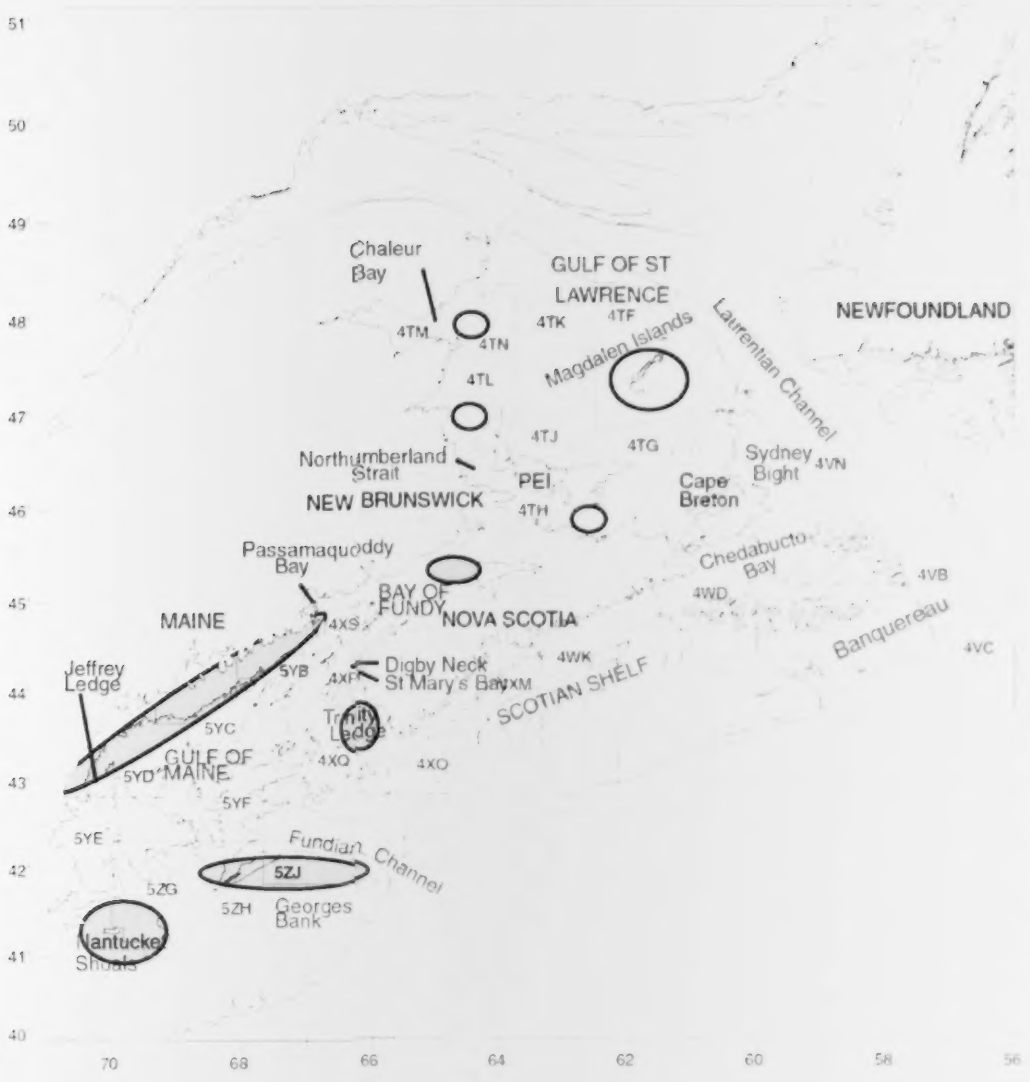


Figure 2. Locations of major herring spawning grounds. Spawning season is indicated by colour as fall (red), spring (green), or both spring and fall (yellow). Common names of geographic features and the boundaries of DFO Statistical Unit Areas mentioned in the text are provided. The 100-meter (blue) and 200-meter (black) contour lines are used to distinguish major depth breaks.

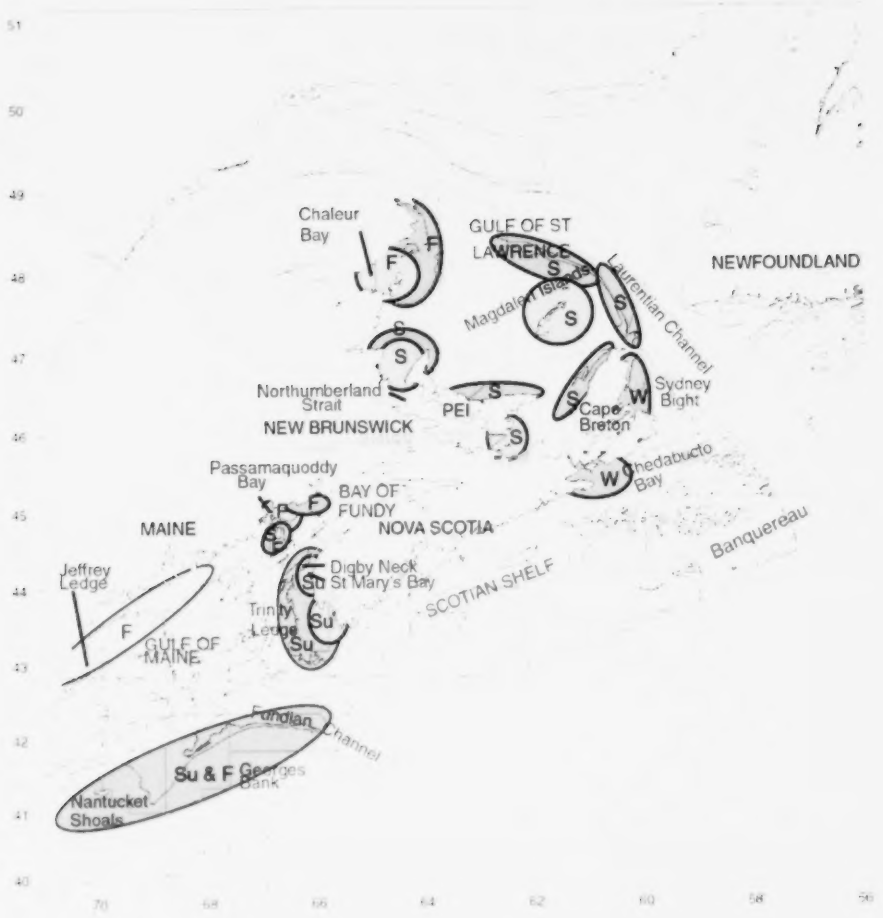


Figure 3. Locations of major herring fisheries prevalent between 1973 and 1985. Dominant gears are indicated by colour as purse seine (red), fixed gear (green), or both (yellow). Common names of geographic features mentioned in the text are provided. Seasonal timing of fisheries is indicated as W=winter, S=spring, Su=summer, and F=fall. The 100-meter (blue) and 200-meter (black) contour lines are used to distinguish major depth breaks.

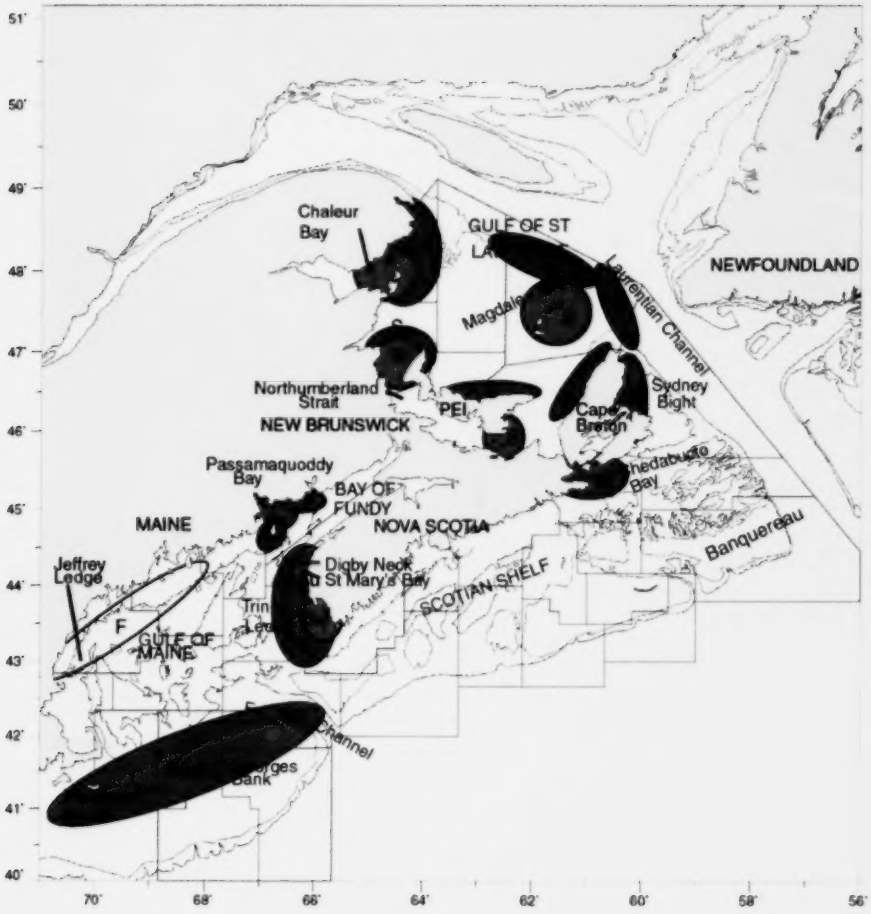


Figure 3. Locations of major herring fisheries prevalent between 1973 and 1985. Dominant gears are indicated by colour as purse seine (red), fixed gear (green), or both (yellow). Common names of geographic features mentioned in the text are provided. Seasonal timing of fisheries is indicated as W=winter, S=spring, Su=summer, and F=fall. The 100-meter (blue) and 200-meter (black) contour lines are used to distinguish major depth breaks.

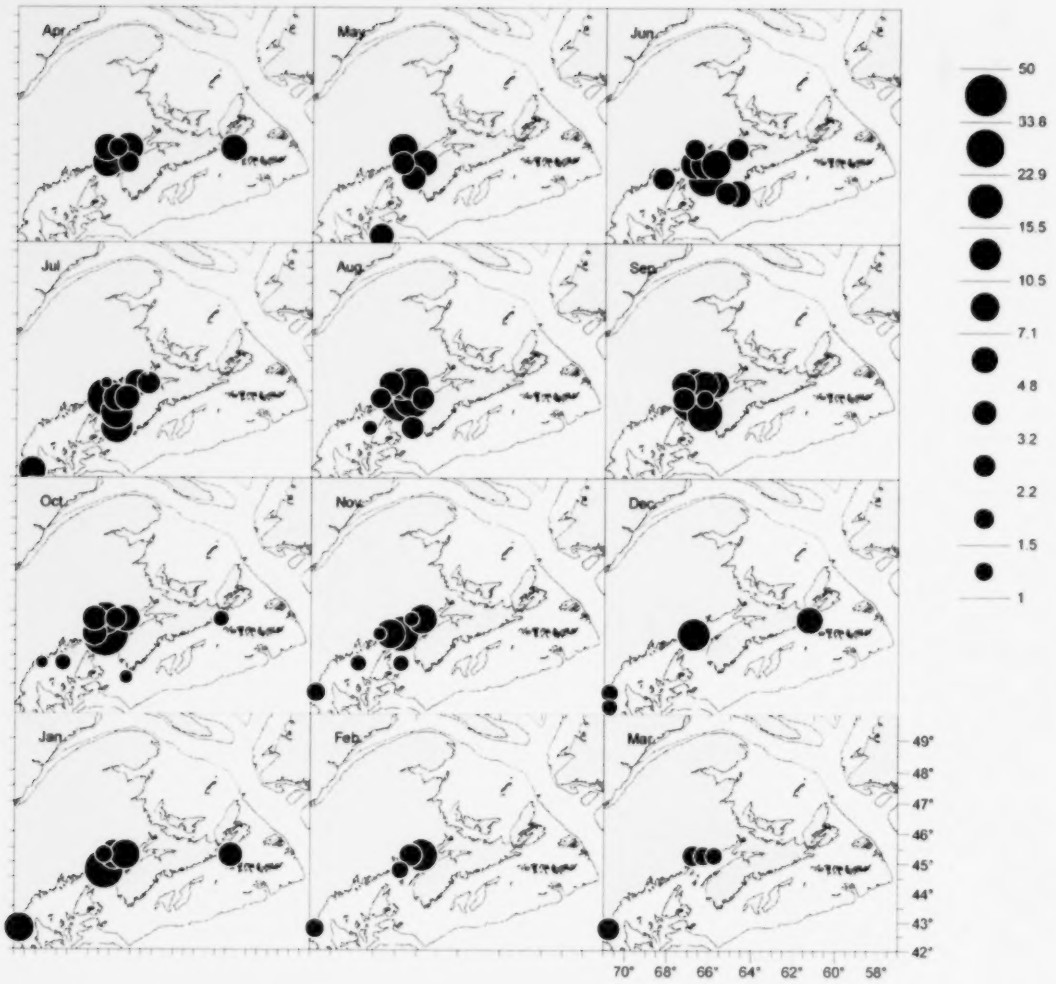


Figure 4a. Recoveries from herring tagged off Grand Manan, June-Dec, 1973-1979. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

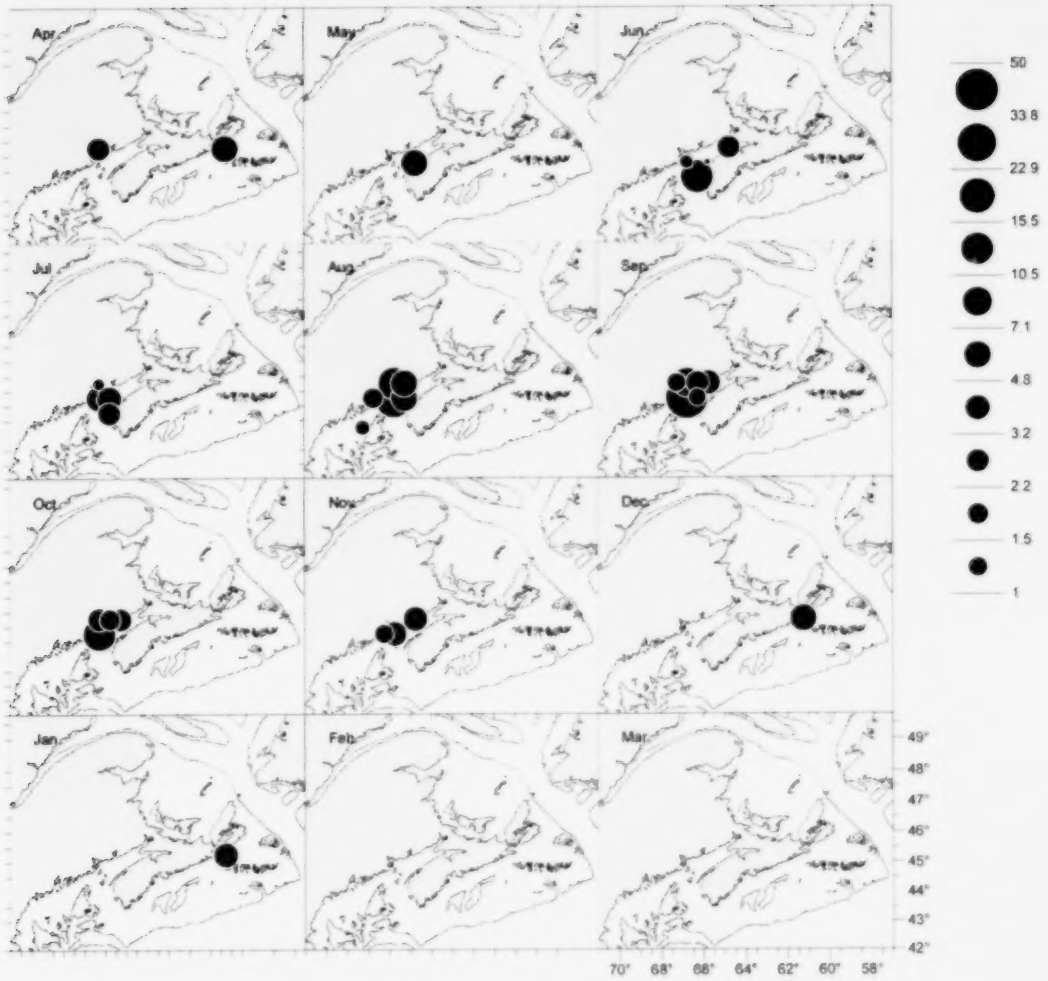


Figure 4b. Recoveries from juvenile herring tagged off Grand Manan during June of 1974. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

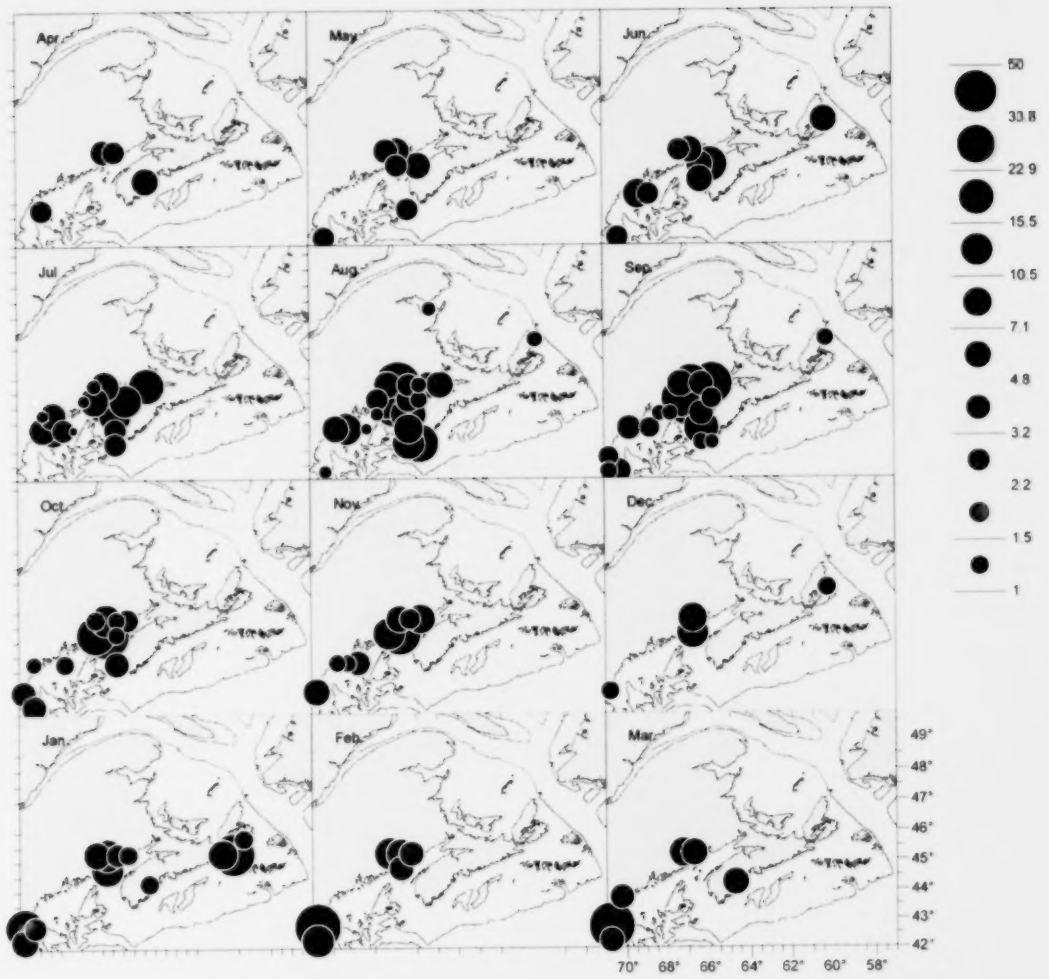


Figure 5a. Recoveries from herring tagged in the entrances to Passamaquoddy Bay during July-Aug, 1974 and 1977. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

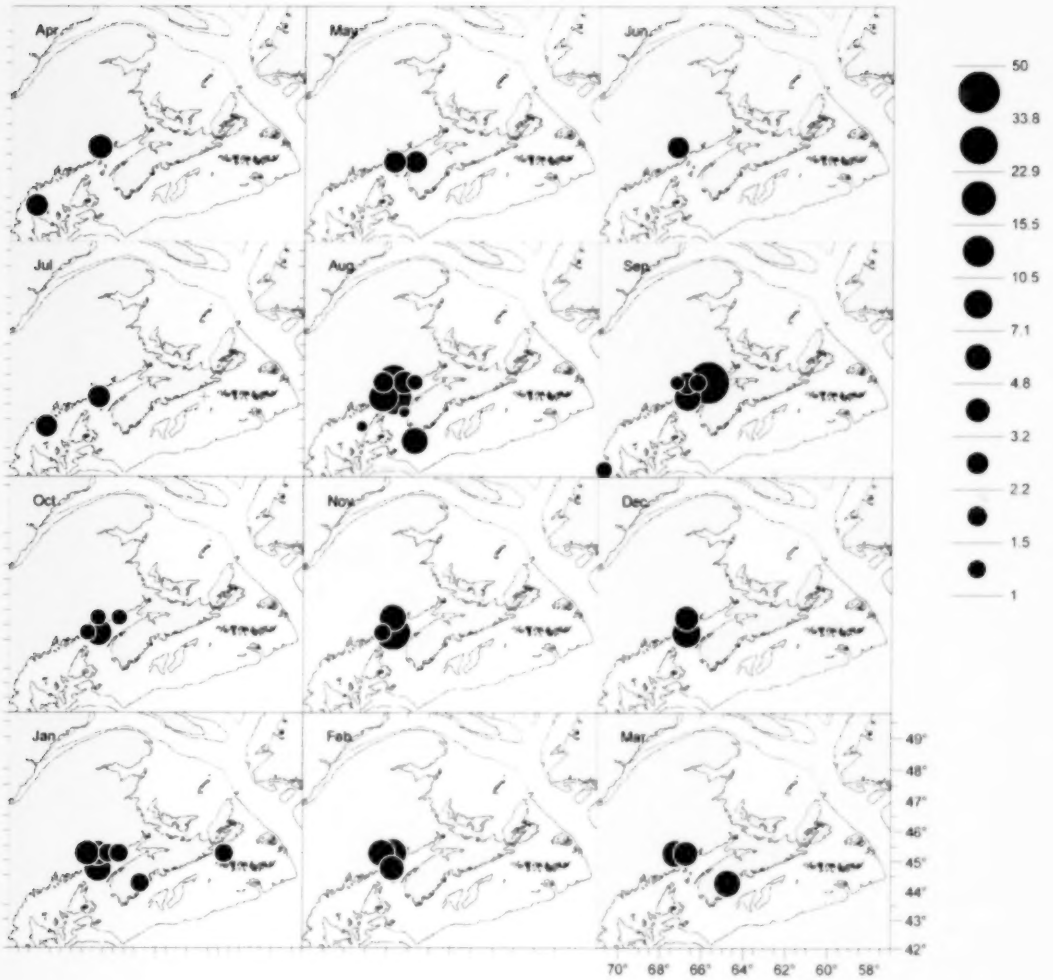


Figure 5b. Recoveries from juvenile herring tagged in the entrances to Passamaquoddy Bay during July-August of 1974 and 1977. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

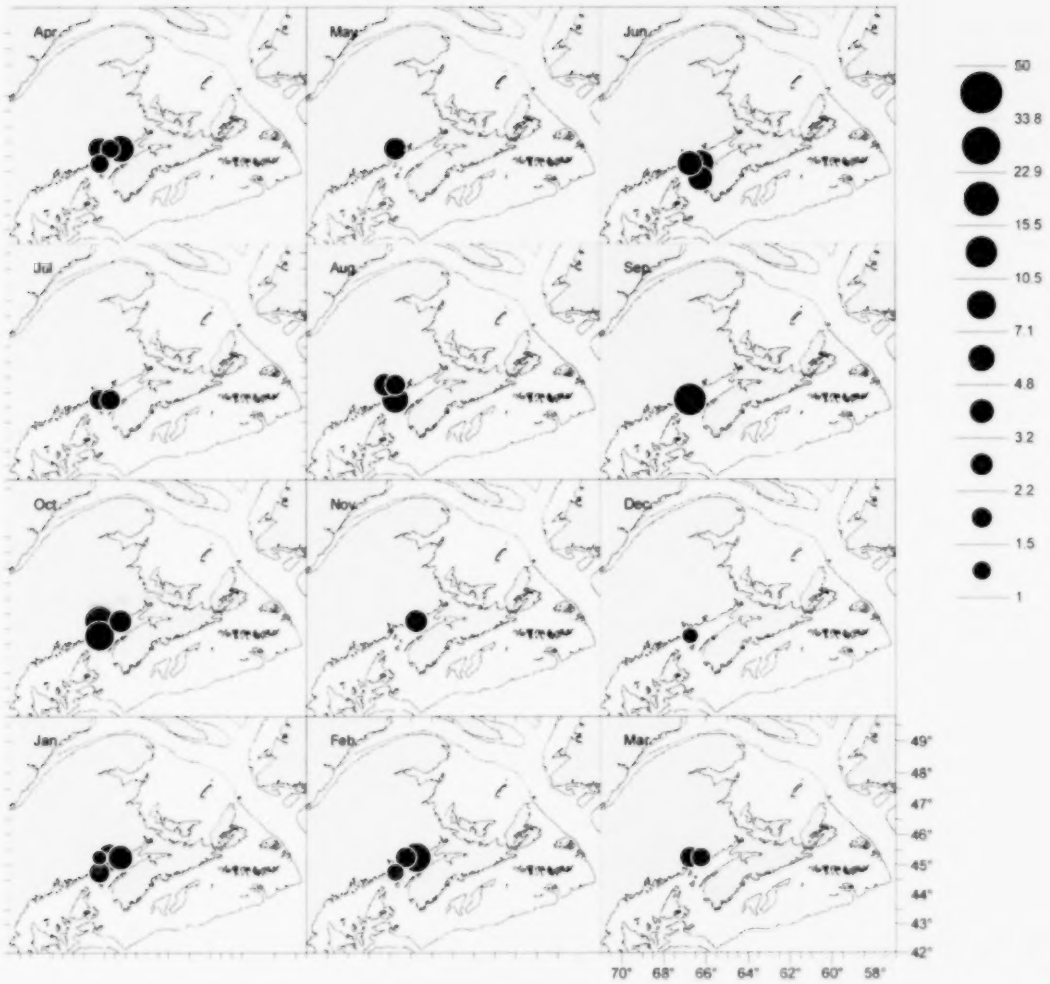


Figure 5c. Recoveries from juvenile herring tagged in the eastern entrance to Passamaquoddy Bay during November of 1973. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

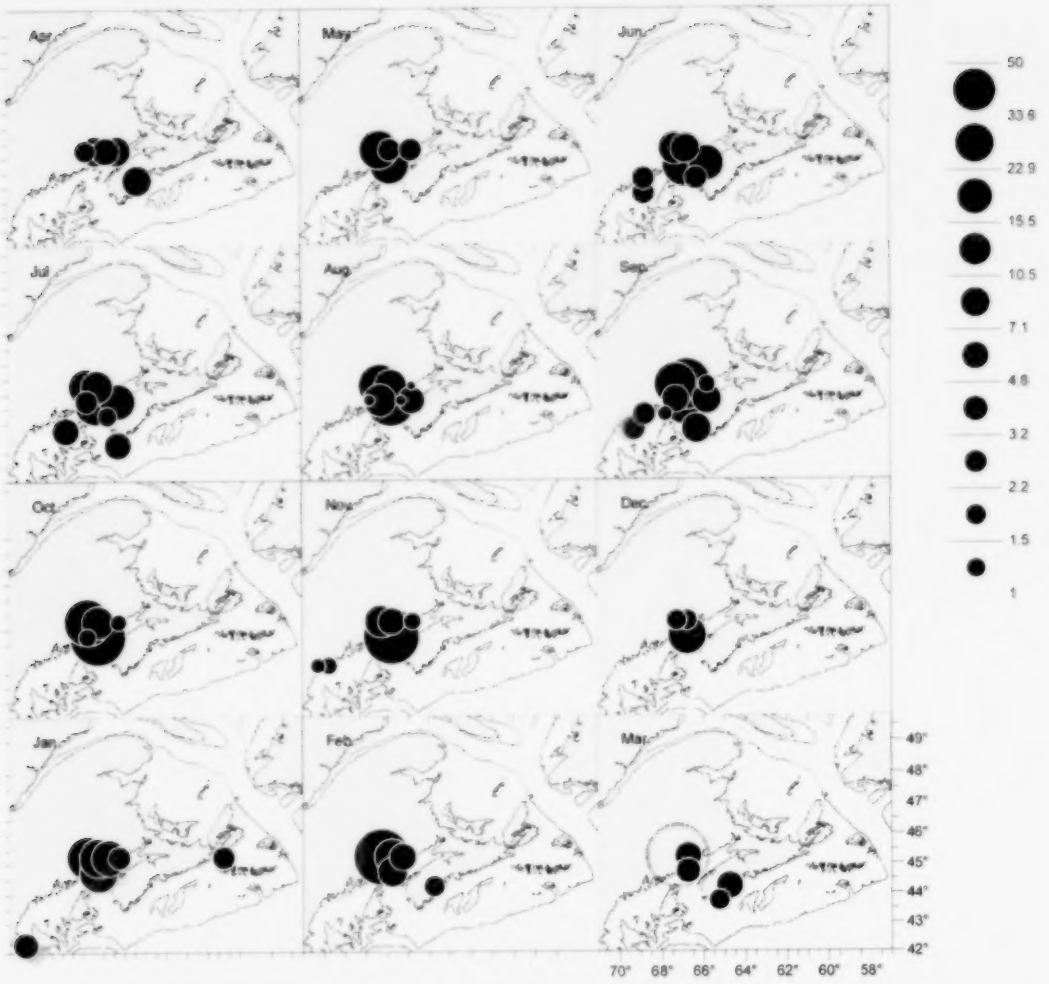


Figure 6a. Recoveries from herring tagged inside Passamaquoddy Bay during Feb-Sept, 1977-1981. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large. Empty circles are used when underlying circles are totally subsumed.

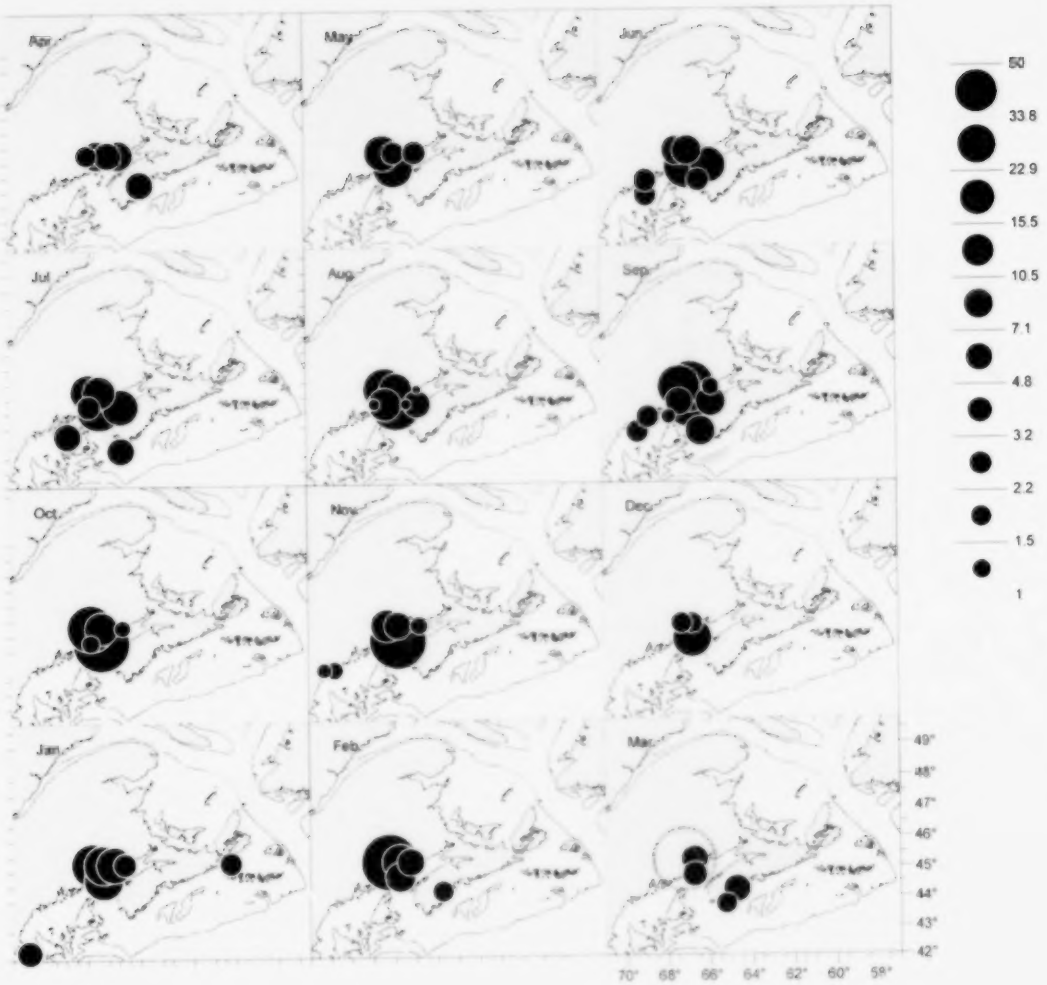


Figure 6b. Recoveries from juvenile herring tagged inside Passamaquoddy Bay during Aug-Sept of 1977 and 1981. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large. Empty circles are used when underlying circles are totally subsumed.

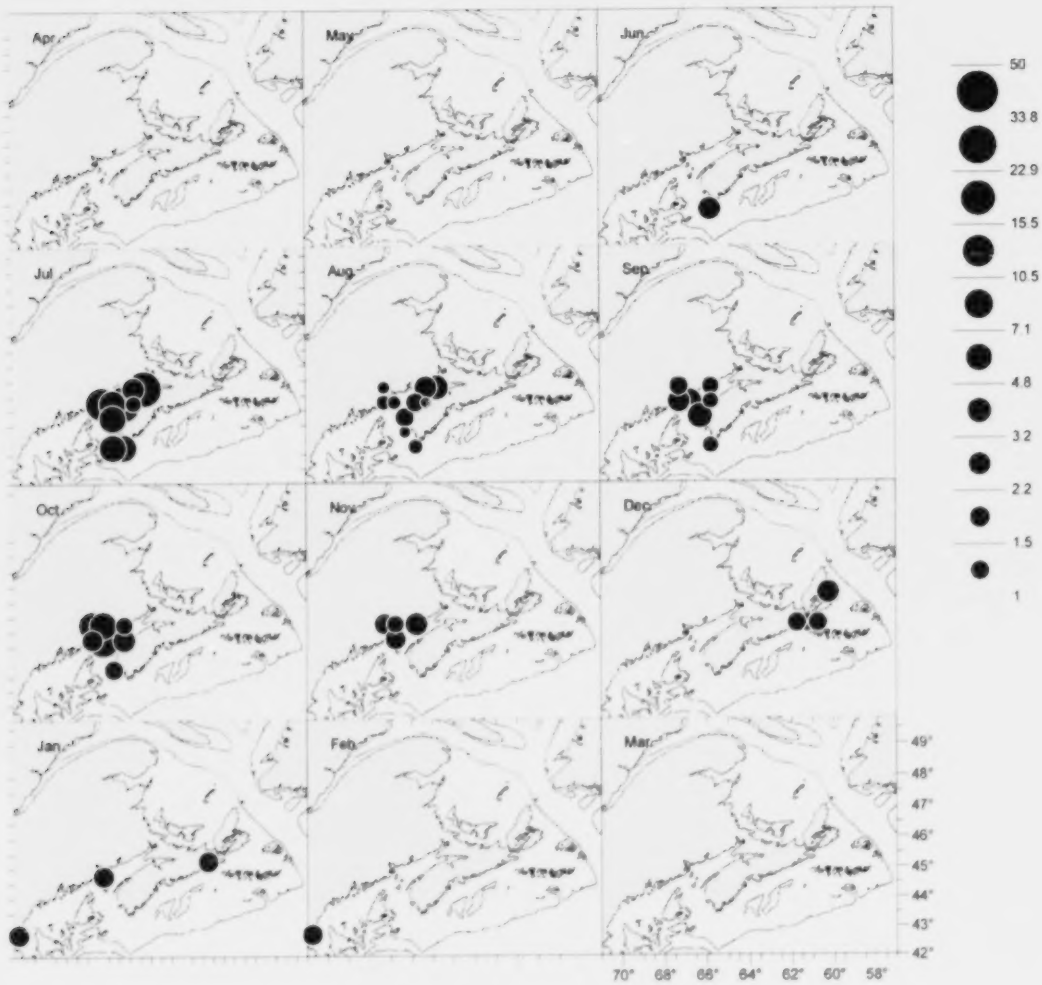


Figure 7. Recoveries from adult (pre-spawning or spawning) herring tagged near Scots Bay (head of Bay of Fundy) during July of 1980 and 1981. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

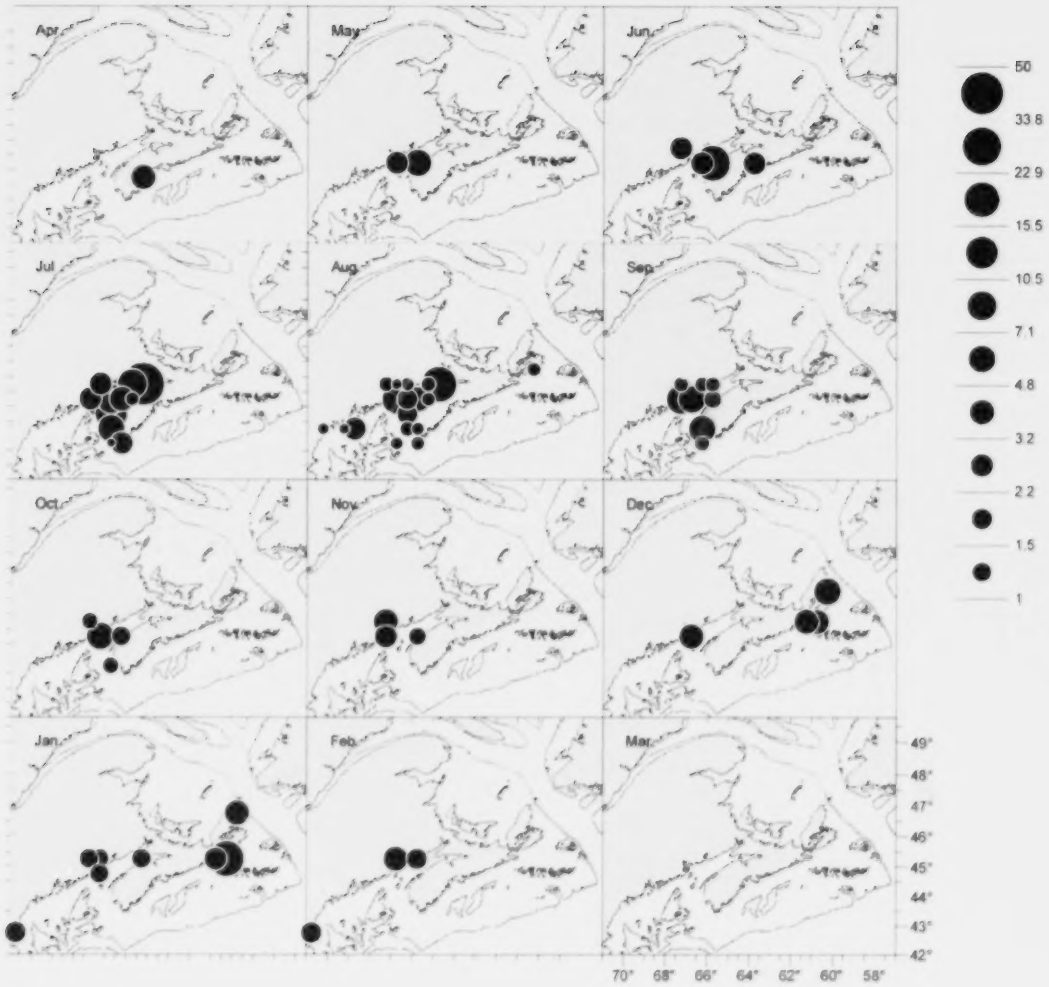


Figure 8a. Recoveries from herring tagged on the Nova Scotian side of the Bay of Fundy from the Annapolis Basin to Morden, during July 1978 and 1980. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

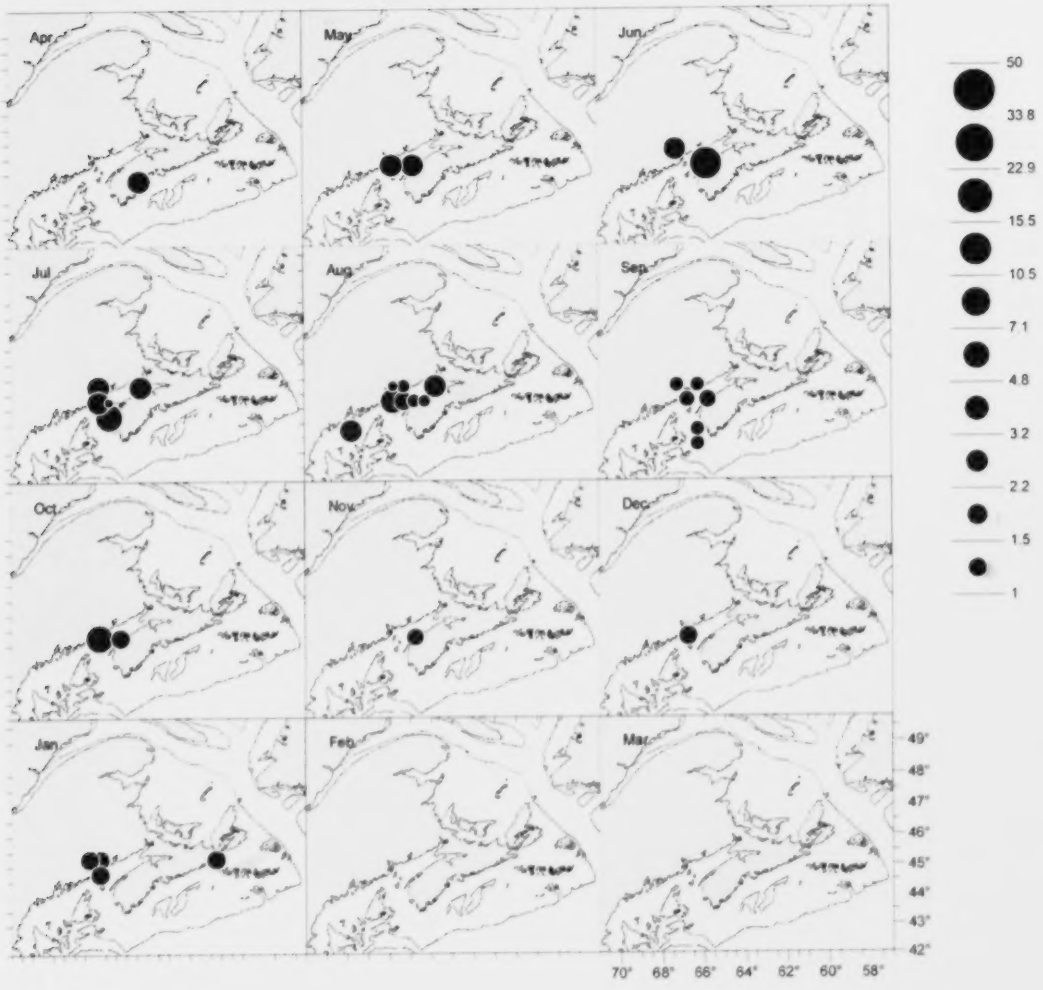


Figure 8b. Recoveries from juvenile herring tagged at the entrance to Annapolis Basin during July of 1978. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

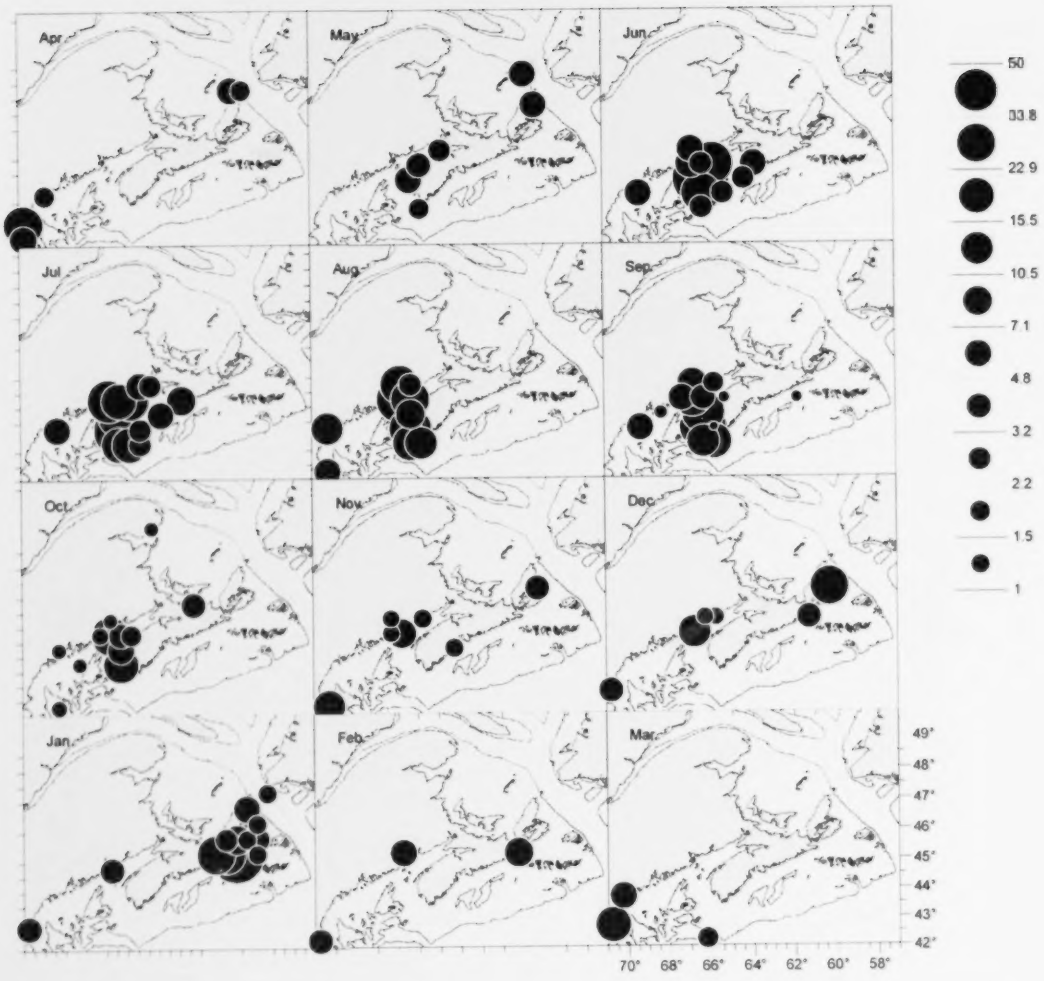


Figure 9. Recoveries from adult herring tagged off southwest Nova Scotia from Digby Neck to Trinity Ledge during June-Sep of 1974 and 1977. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

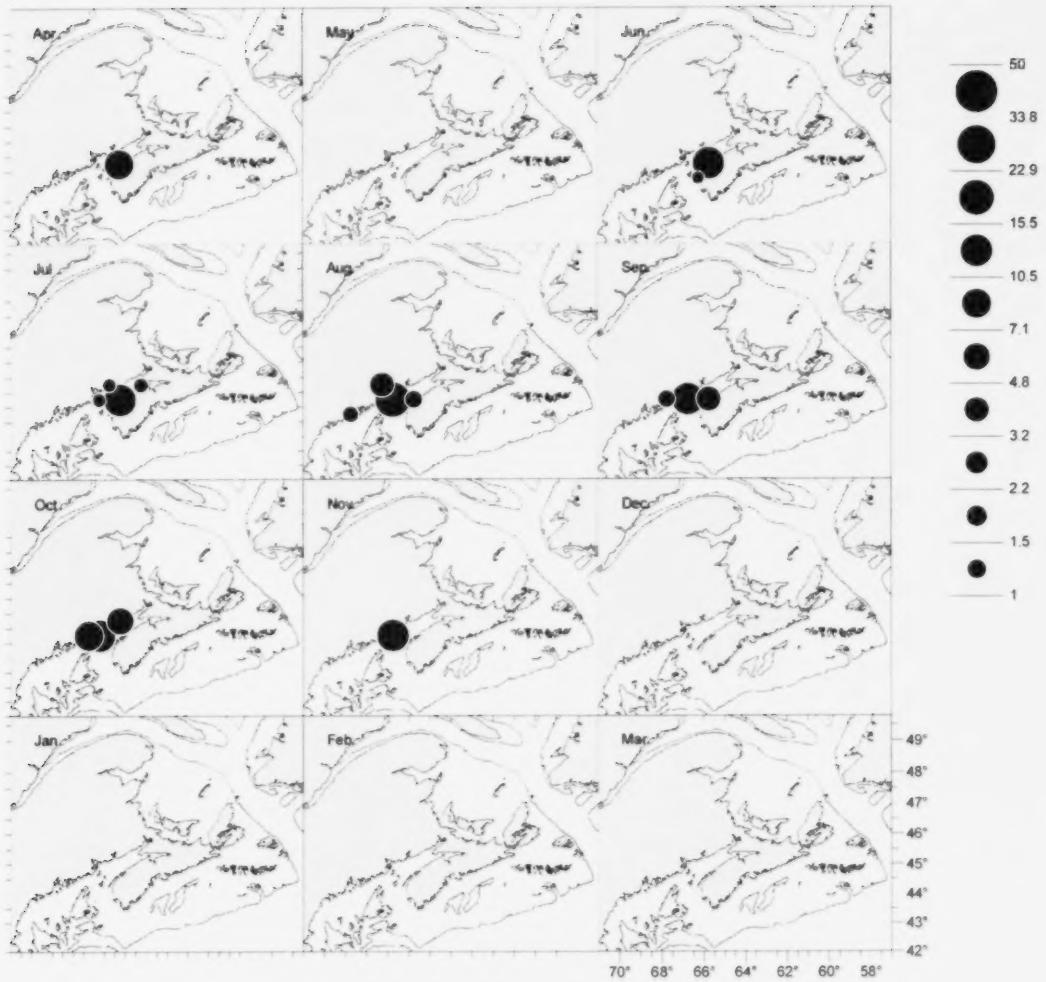


Figure 10. Recoveries from juvenile herring tagged in St Marys Bay during June of 1979. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

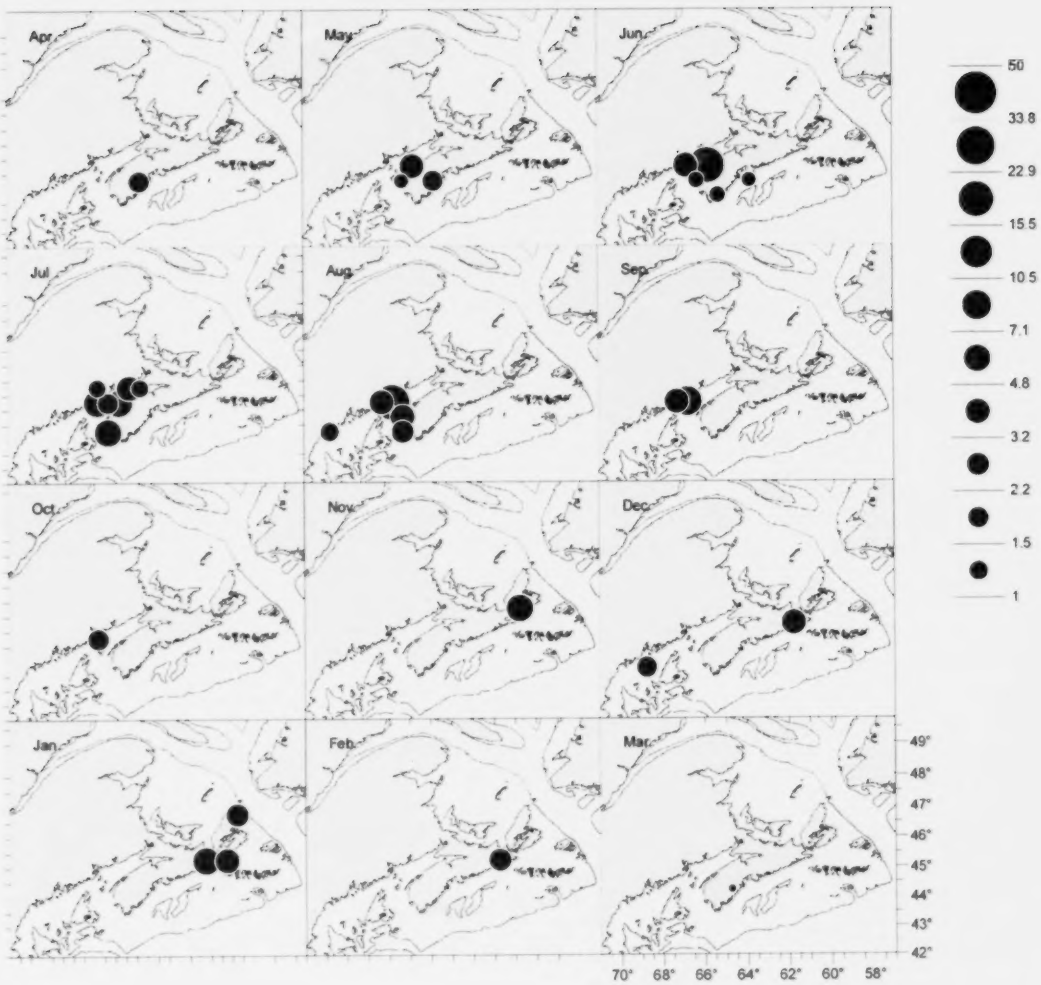


Figure 11a. Recoveries from herring tagged from Western Head to St Margarets Bay during Mar-April 1978-1980. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

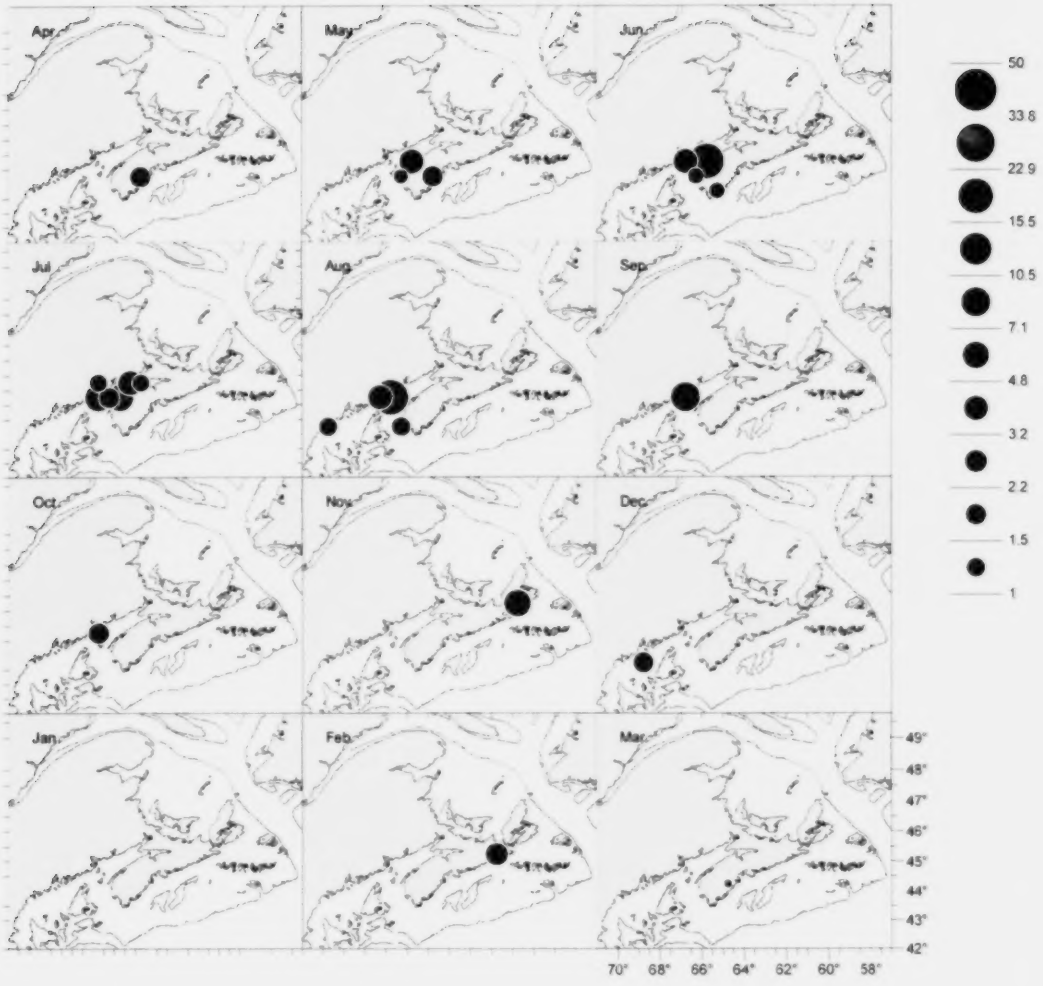


Figure 11b. Recoveries from juvenile herring tagged off Western Head during Mar-April of 1978-1979. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

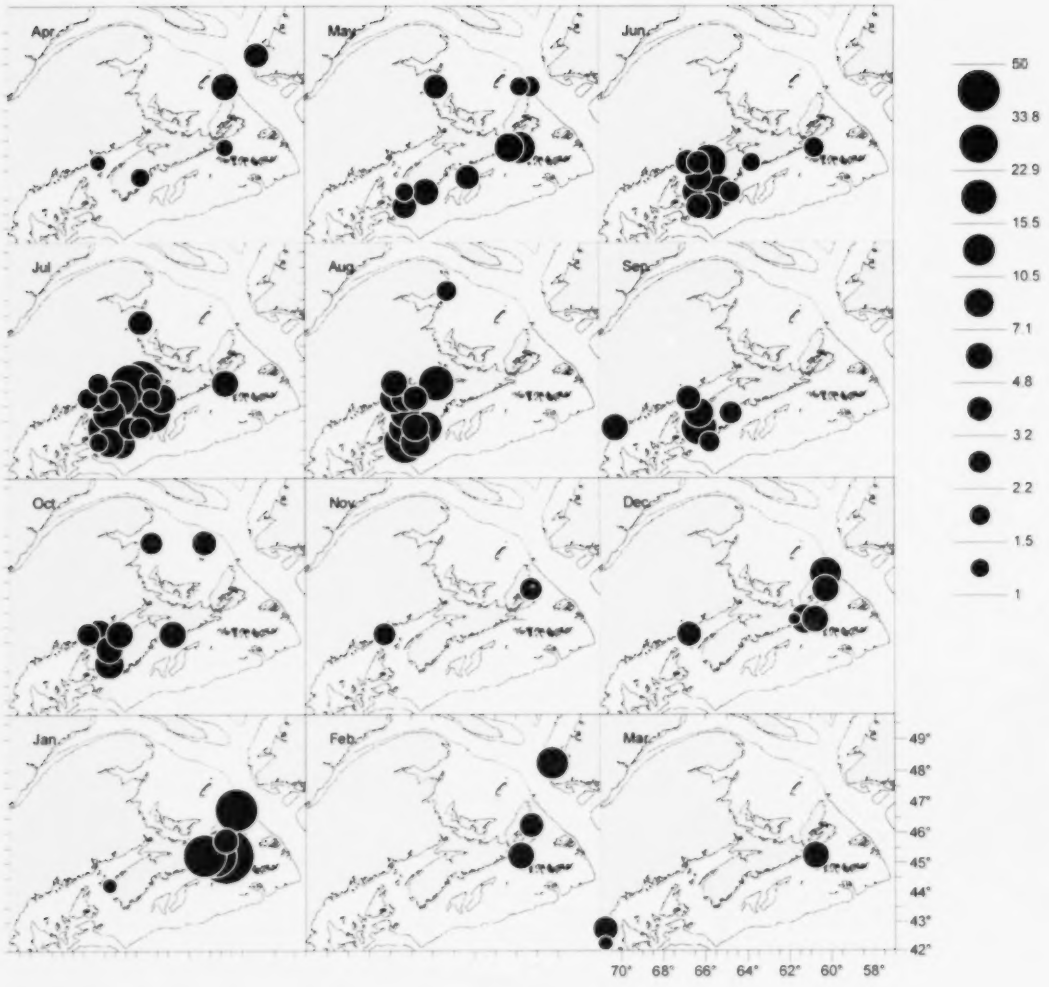


Figure 12a. Recoveries from herring tagged in or near Chedabucto Bay during the winters of 1976-1980. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

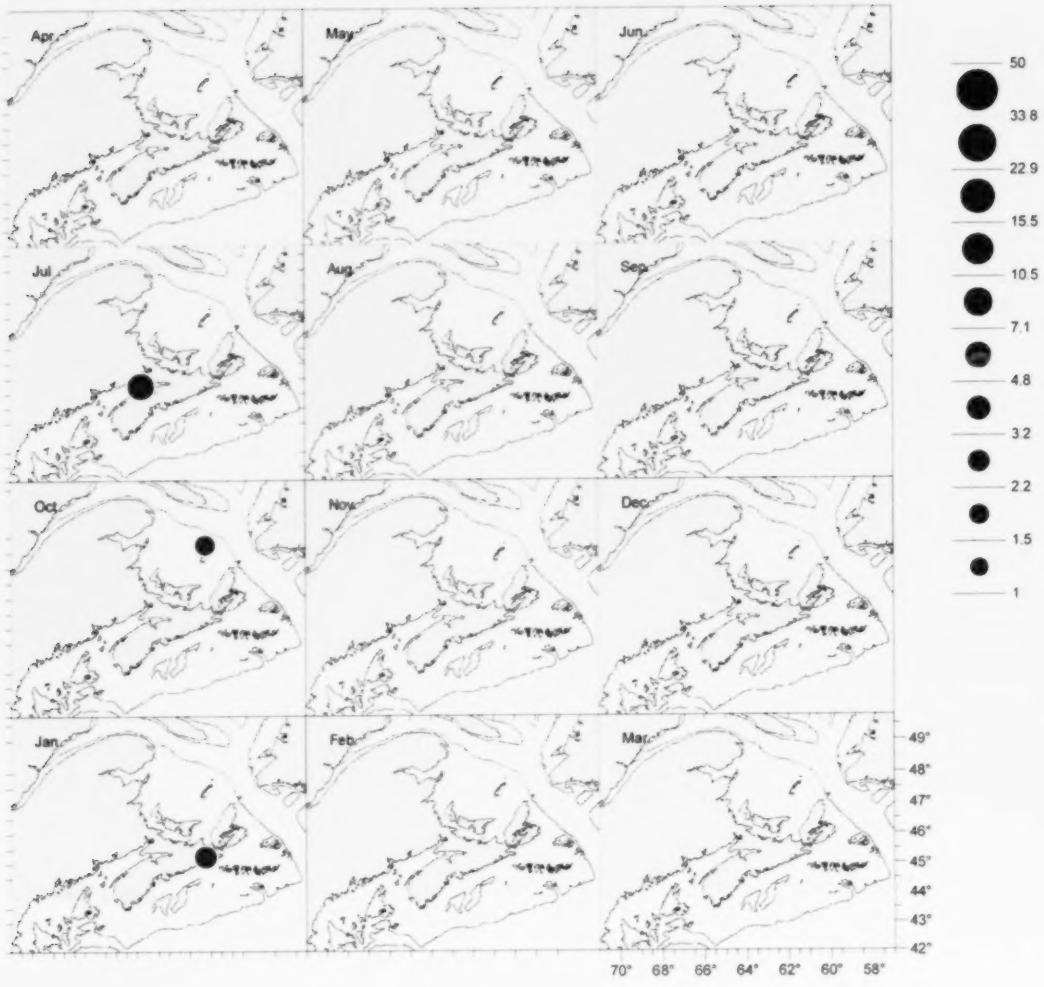


Figure 12b. Recoveries from juvenile herring tagged in or near Chedabucto Bay during February of 1976. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

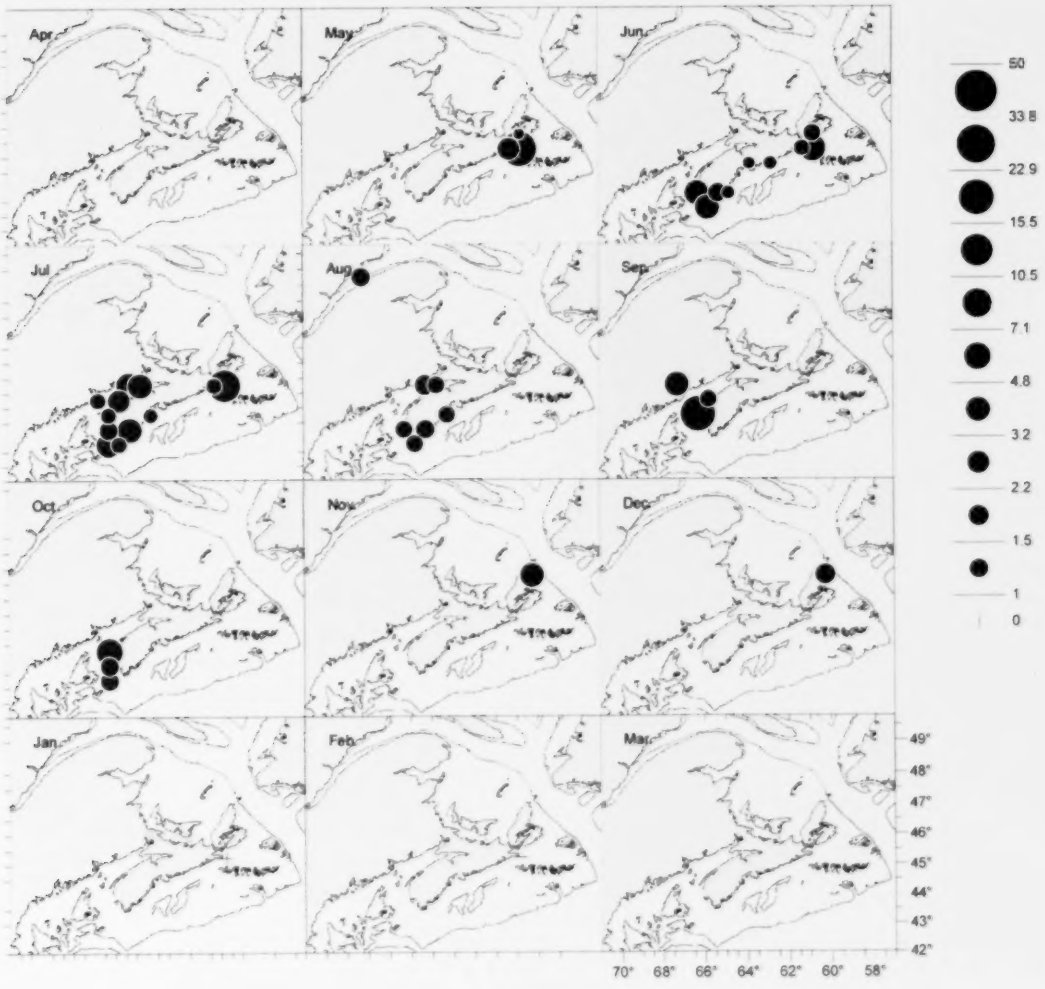


Figure 13. Recoveries from adult herring tagged in or near Chedabucto Bay during April-May, 1980 and 1982. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

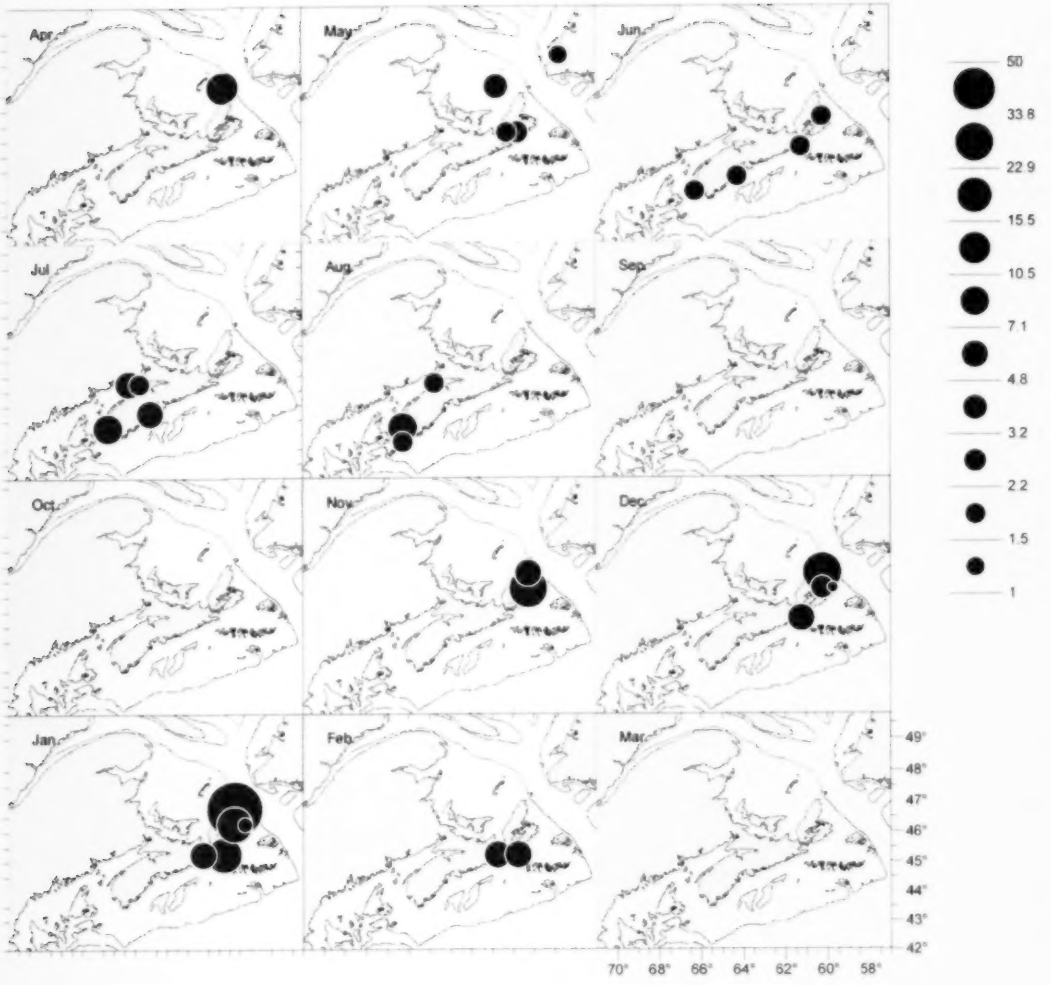


Figure 14. Recoveries from adult herring tagged east of St Annes Bay in Sydney Bight during the winters of 1977-1978. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

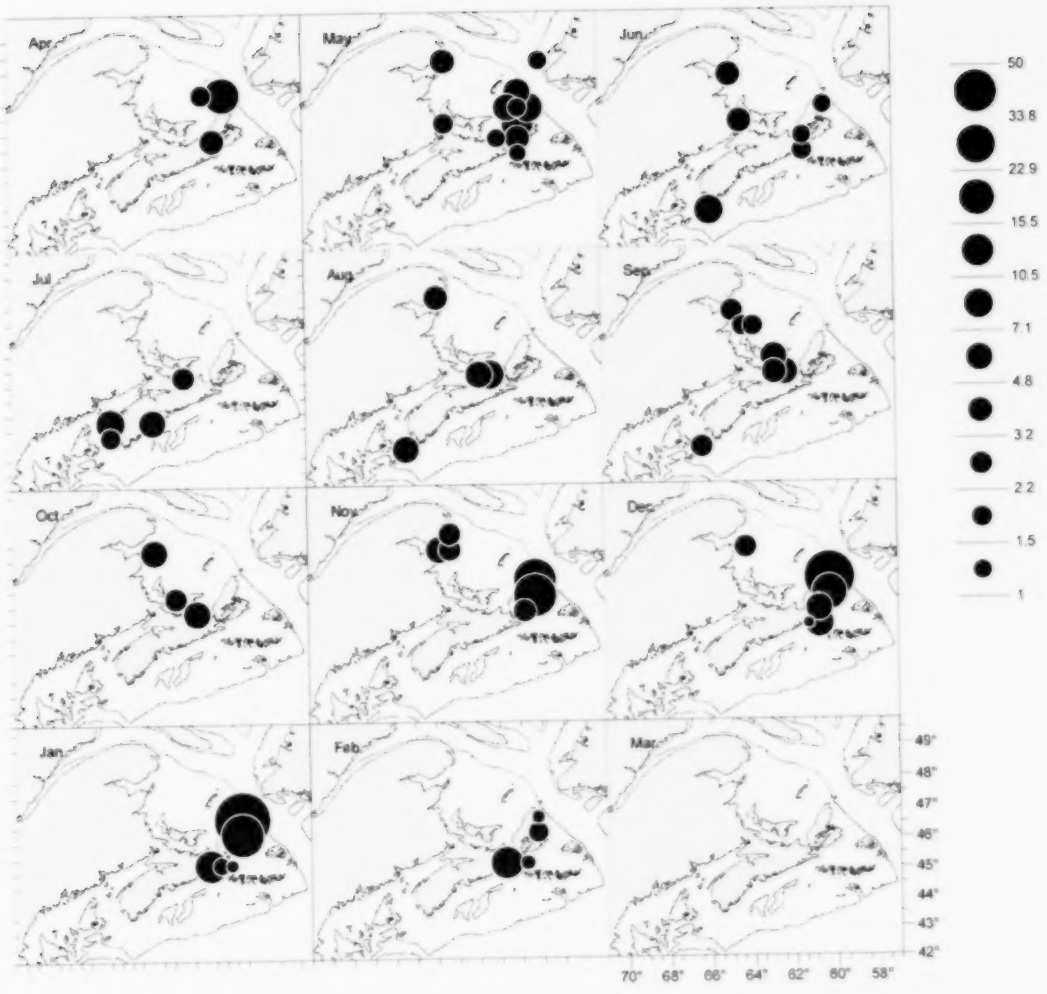


Figure 15. Recoveries from adult herring tagged north of St Annes Bay in Sydney Bight during the winters of 1978-1980. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

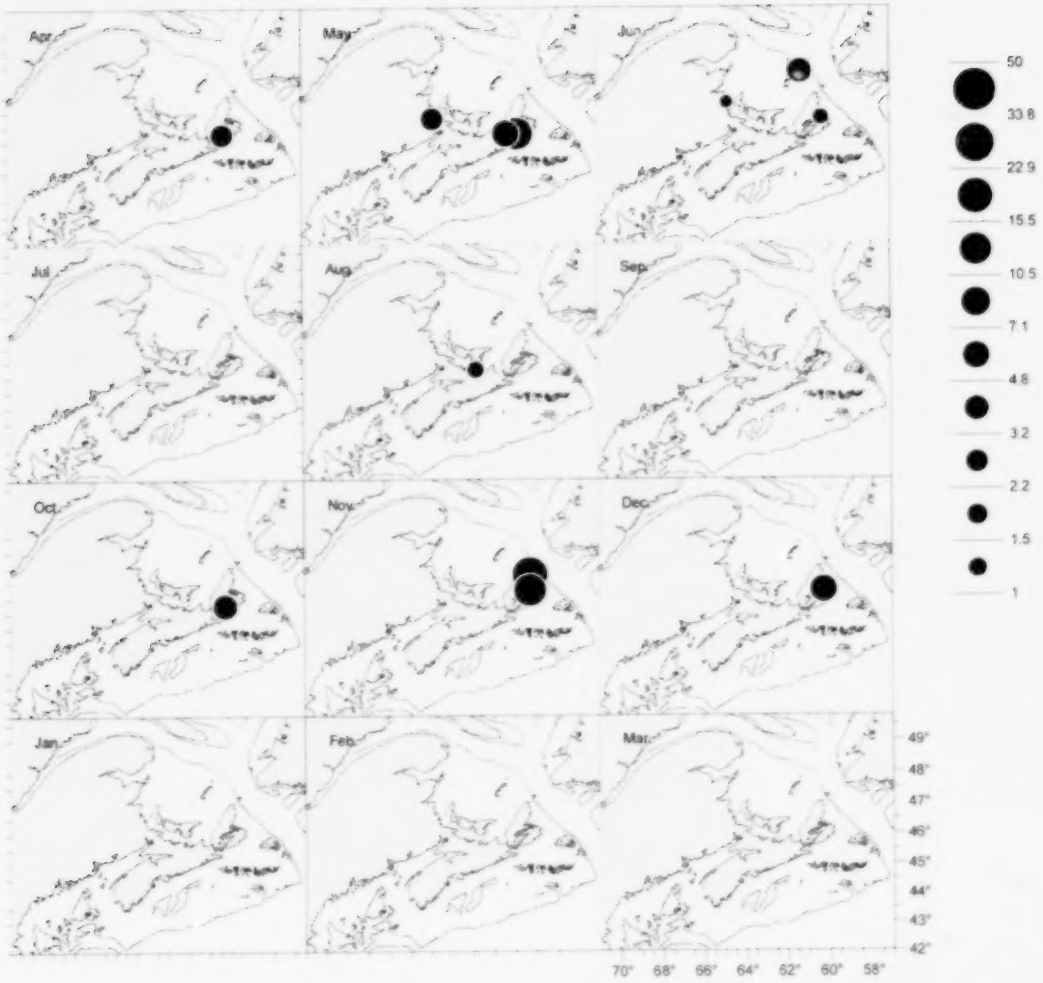


Figure 16. Recoveries from adult herring tagged in St Annes Bay in Sydney Bight during the spring of 1981. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

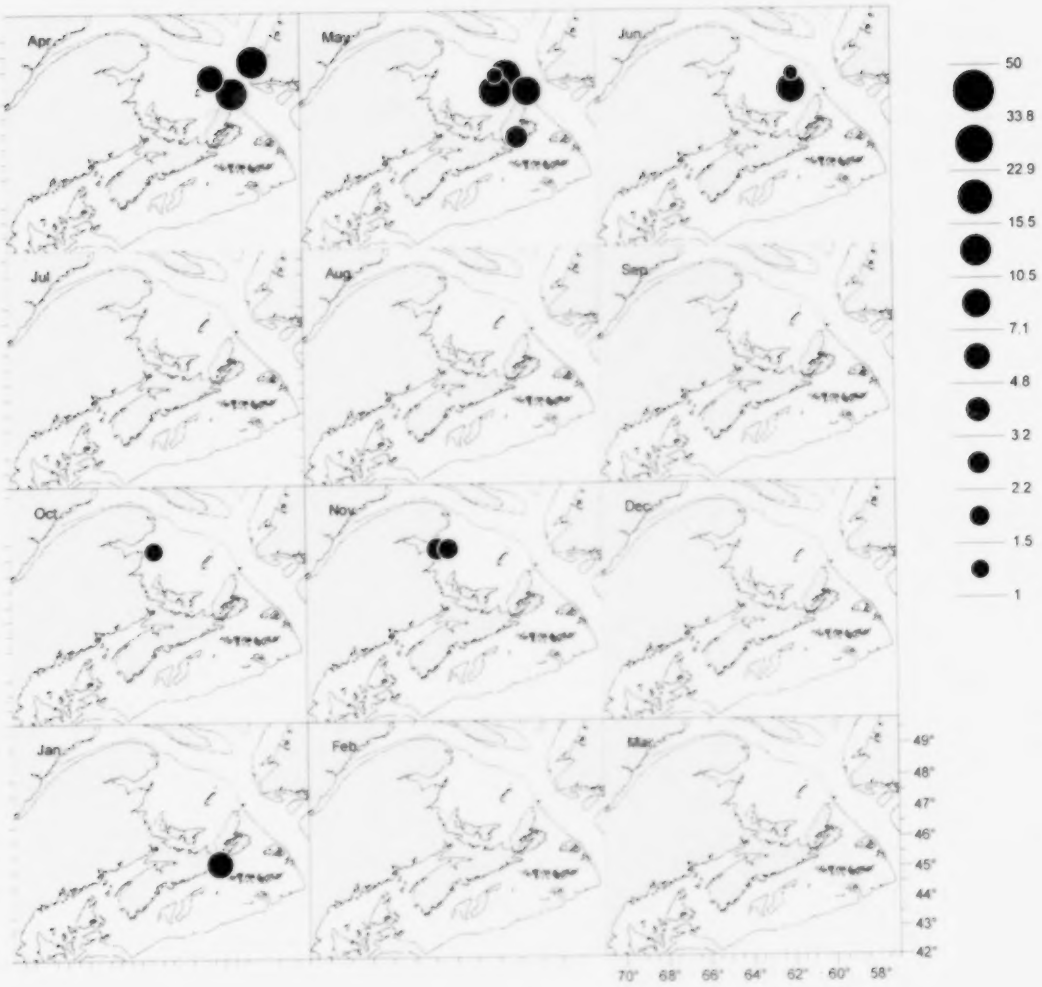


Figure 17. Recoveries from adult herring tagged near the Magdalen Islands in May of 1976. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

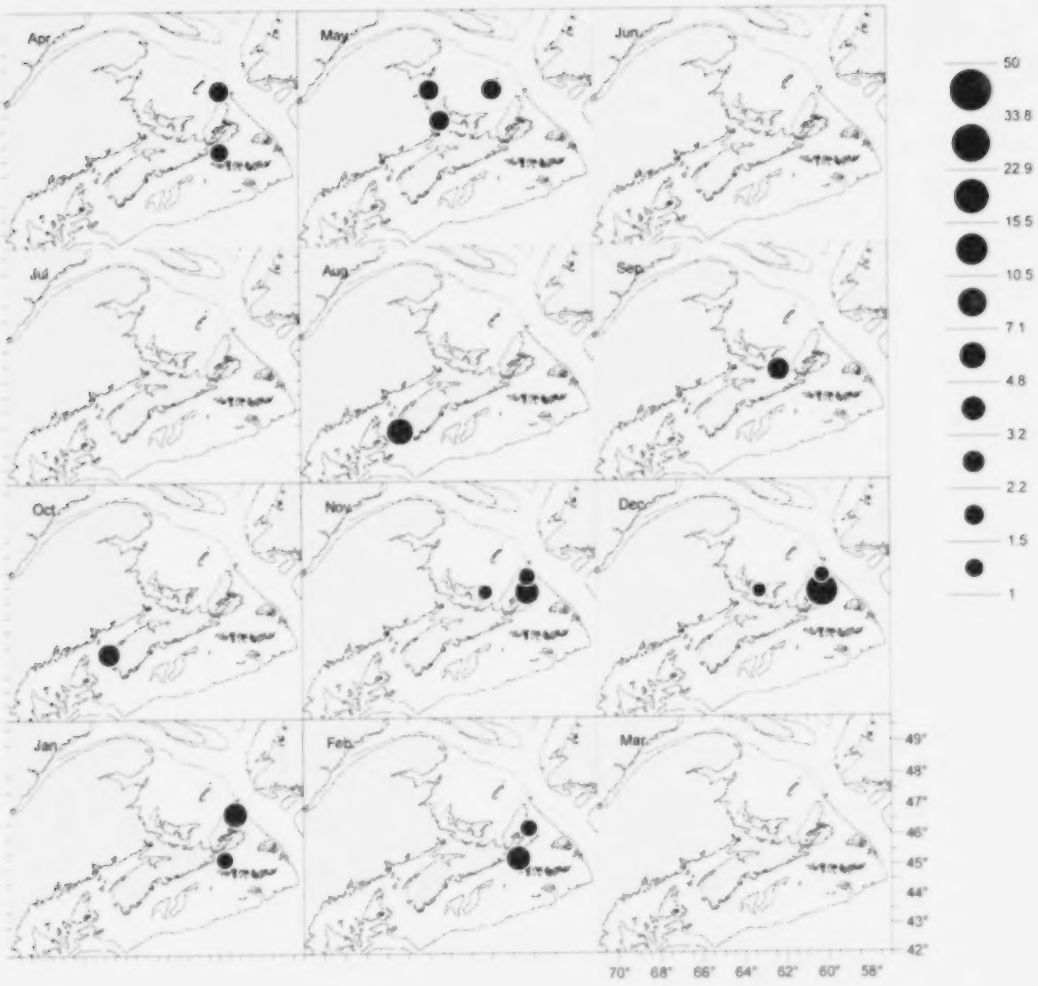


Figure 18. Recoveries from adult herring tagged near Souris, Prince Edward Island in October of 1978 and 1981. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large.

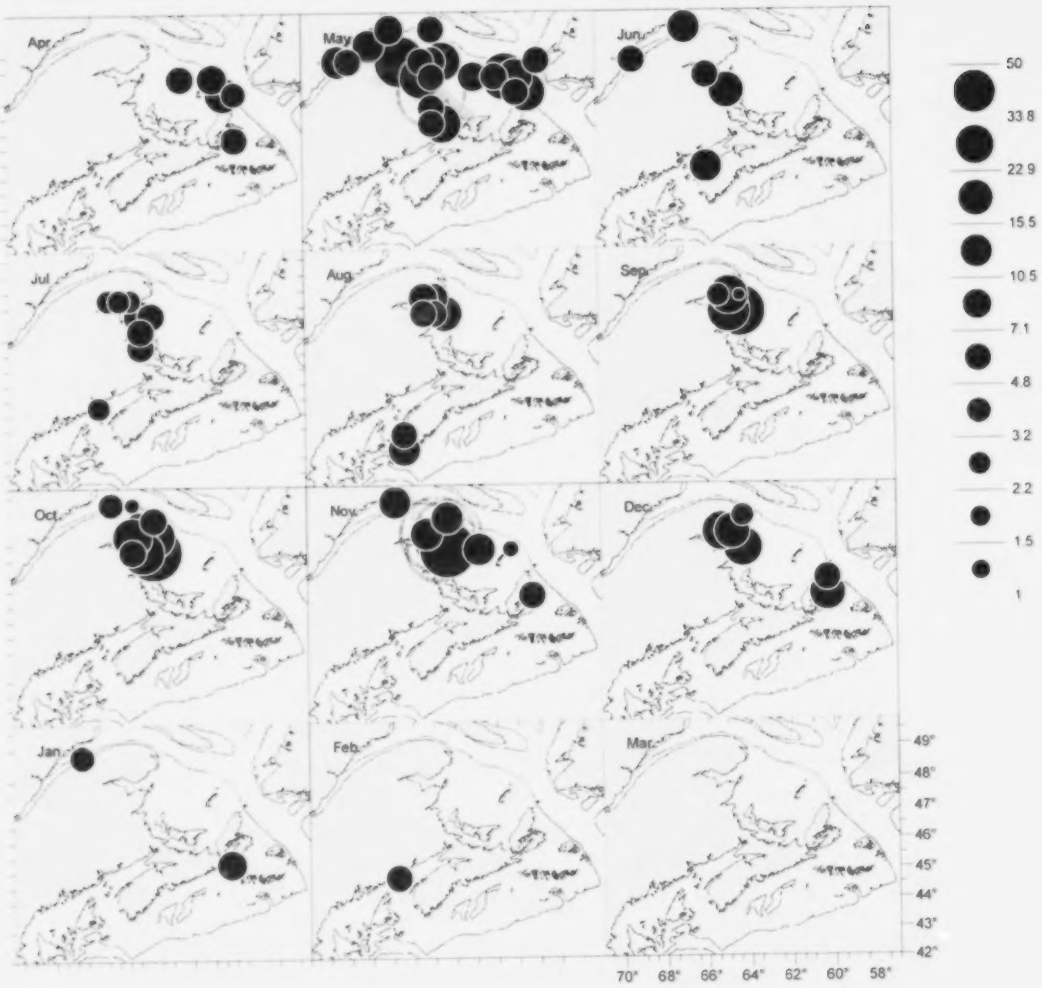
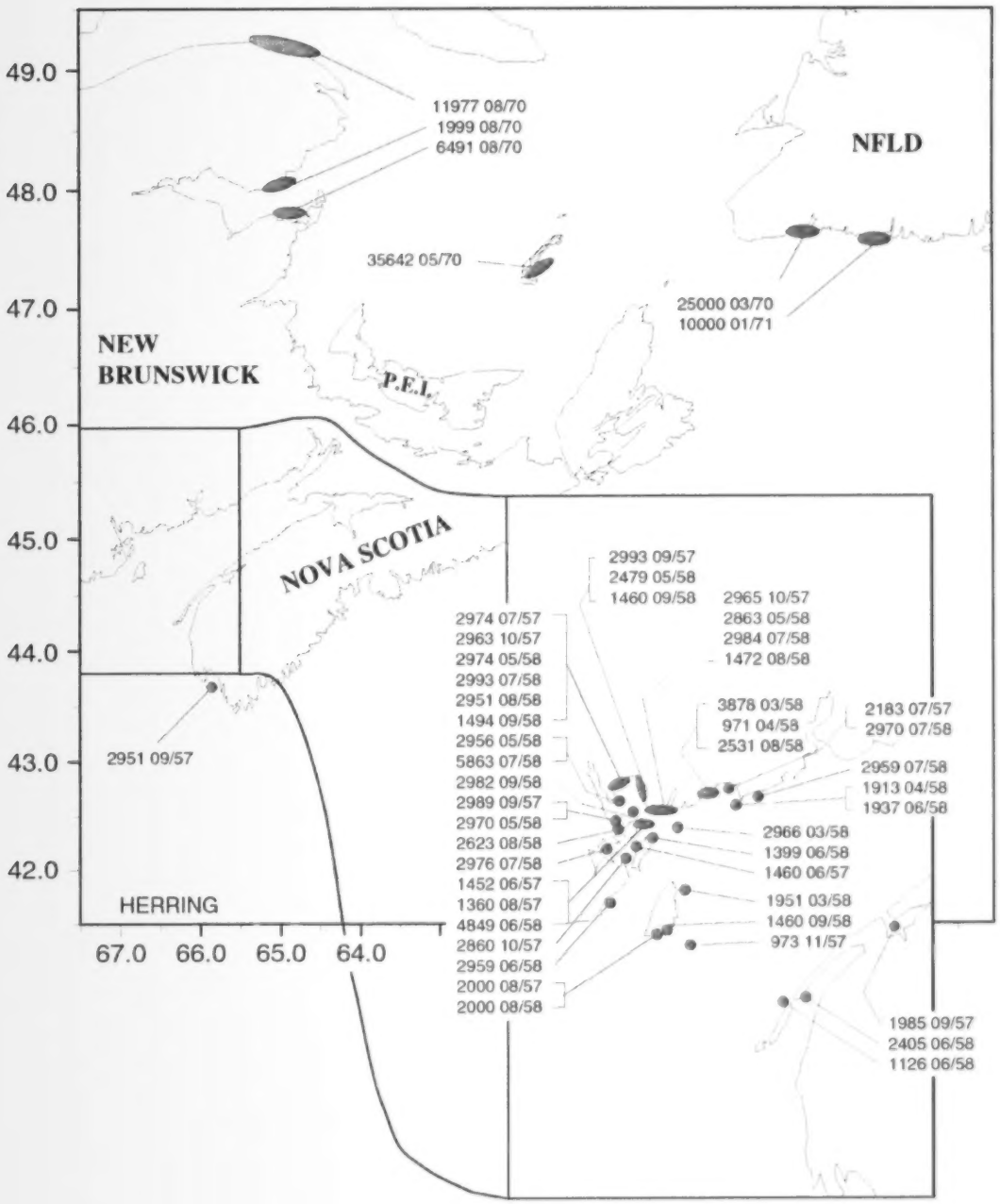


Figure 19. Recoveries from herring (mostly juveniles) tagged in the Bay of Chaleur during Aug.-Sept. of 1976. About 10% of the herring were spawning adults. Recoveries are aggregated over years and 5 minute squares, and plotted separately for each month. Recoveries are weighted by days at large. Empty circles are used when underlying

Appendix 1. Geographic locations, dates and numbers tagged in studies of herring populations found in the Bay of Fundy during 1957-58 and the southern Gulf of St. Lawrence in 1970-71. Discrete releases of herring in close geographic proximity and/or size have been combined in this composite map. The mark:recapture data from these studies was not preserved electronically, so is not included in any currently existing tagging database.



Appendix 1. Geographic locations, dates and numbers tagged in studies of herring populations found in the Bay of Fundy during 1957-58 and the southern Gulf of St. Lawrence in 1970-71. Discrete releases of herring in close geographic proximity and/or size have been combined in this composite map.

Appendix 2. Summaries of the Atlantic herring tagging project, 1973-82, release and recovery information (after Stobo and Fowler, 2006).

2.1 Geographic locations, numbers, and month and year of release of herring tagged in the northwest Atlantic in 1973-82 between the Bay of Fundy and Chedabucto Bay. In many cases several discrete releases of close geographic proximity and/or size range of fish were combined for this composite map.

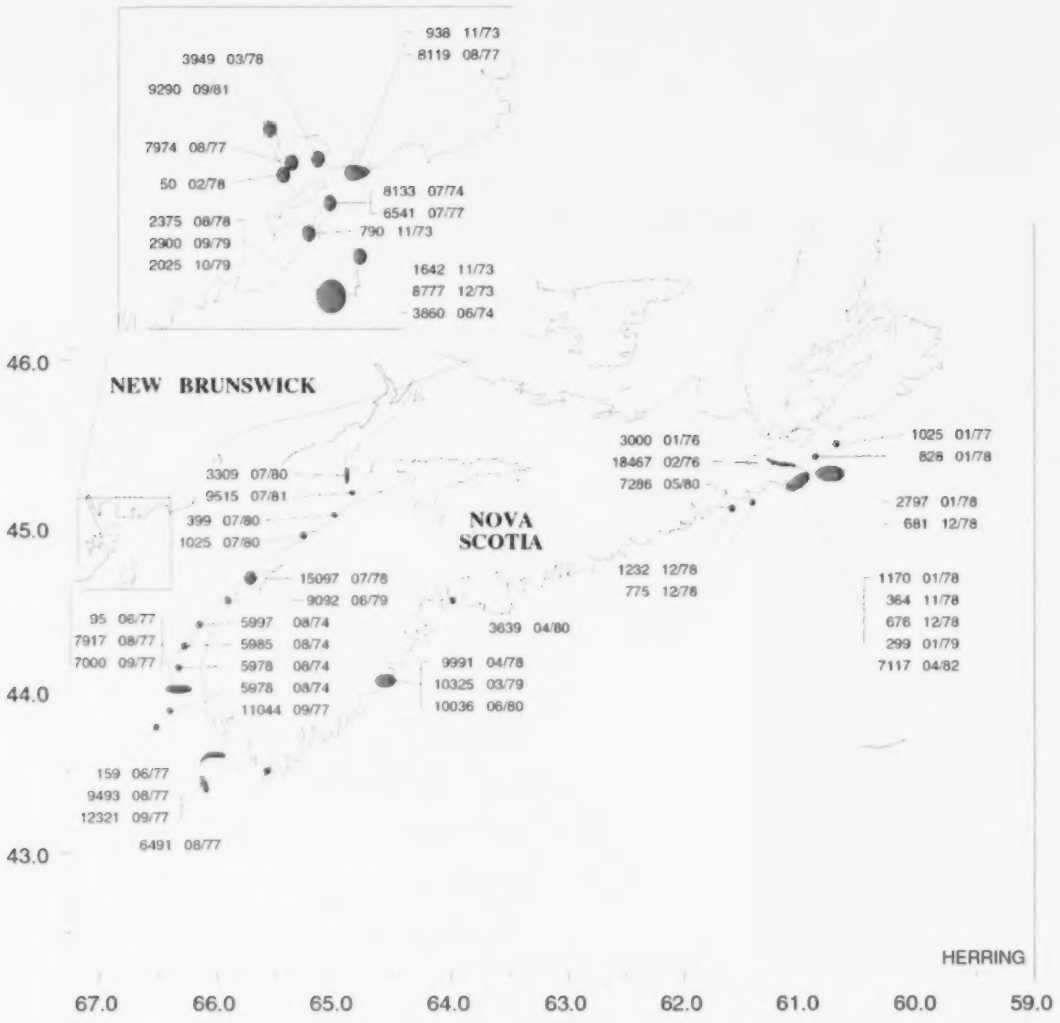
2.2 Geographic locations, numbers, and month and year of release of herring tagged in the northwest Atlantic in 1976-81 in the Gulf of St. Lawrence and off Cape Breton Island, Nova Scotia. In many cases several discrete releases of close geographic proximity and/or size range of fish were combined for this composite map.

2.3. Tag release and recovery information by year, month and statistical unit area of NAFO Subarea 4 in which herring tagging was conducted during the project. In most unit areas, several tagging events occurred within the months listed; these have been combined for the purposes of this table. The detailed information is available in the tagging database as described in Stobo and Fowler (2006).

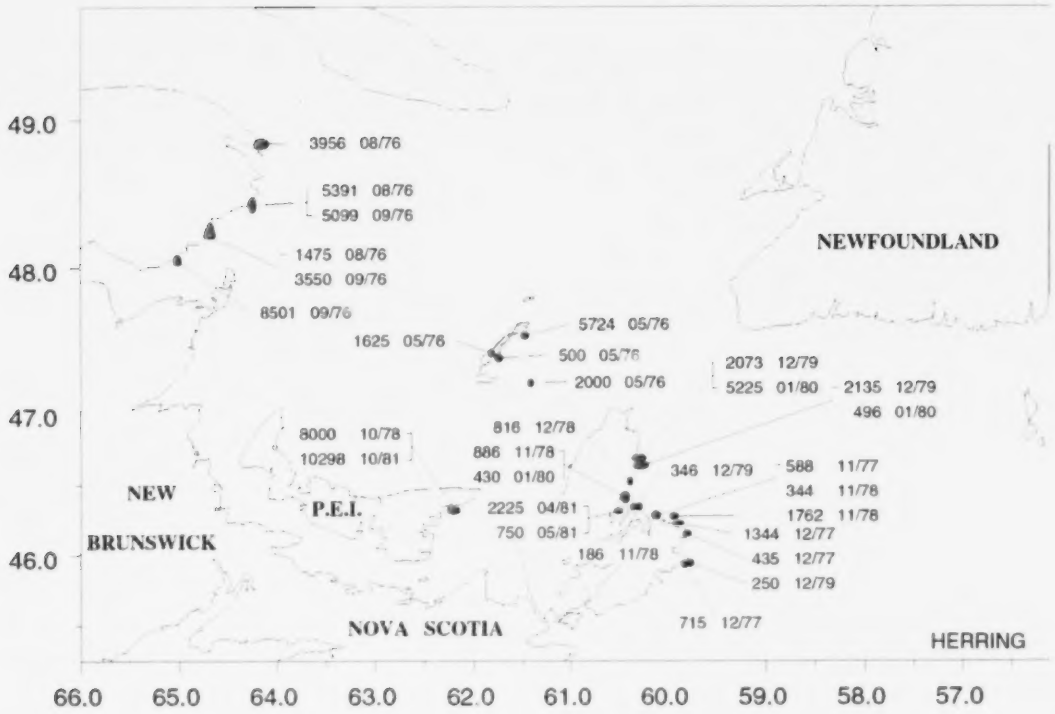
2.4. Number of overall recoveries and effect of information omission on the number of usable recoveries for analysing movements and migrations. The omissions were due to the individual recovering the tag not reporting details of the prime recovery parameters, date and location.

2.5. Temporal breakdown of tag returns demonstrating the preponderance of recoveries during the first 3 months after release and the reduction in tag recoveries in subsequent years.

2.6. Length frequency samples associated with herring tagged between 1973 and 1982. Tagged herring were not individually measured, rather a length frequency subsample was taken from each set from which herring were tagged. The length frequencies have been grouped by time period and unit area for brevity in this report, hence contributing to the large numbers. In some field operations however, large numbers were measured as a result of the tagging project protocol in which herring were tagged from purse seine sets each night of the chartered purse seine vessel, or from successive sets from several fishing vessels fishing in close proximity, on which we had placed research staff; under these conditions, only small numbers of herring were tagged from each set in order to not impede the commercial operation.



Appendix 2.1. Locations of tagging releases of Atlantic herring in NAFO Subarea 4 between 1973 and 1982. The numbers of fish tagged and the month and year of release are given for each release location. In many cases several discrete releases of close geographic proximity and/or size range of fish were combined for this composite map.



Appendix 2.2. Geographic locations, numbers, and months and year of release of herring tagged in the northwest Atlantic in 1976-81 in the Gulf of St. Lawrence and off Cape Breton Island, Nova Scotia. In many cases several discrete releases of close geographic proximity and/or size range of fish were combined for this composite map.

Appendix 2. 3. Herring Tag Recovery Information by Year, Month and Location. All release events within a month within the specified NAFO area have been combined.

Year	Month	NAFO Area	Number Released	Number Recovered	Percent Recovered
1973	Nov	4XS	3370	113	3.4
1973	Dec	4XS	8777	184	2.1
1974	Jun	4XS	3860	213	5.5
1974	Jul	4XS	8133	614	7.6
1974	Aug	4XQ	5978	91	1.5
1974	Aug	4XR	17960	357	2.0
1976	Jan	4WD	3000	2	0.1
1976	Feb	4WD	12692	3	0.0
1976	May	4TF	9849	237	2.4
1976	Aug	4TN	10822	340	3.1
1976	Sep	4TM	8501	453	5.3
1976	Sep	4TN	8649	545	6.3
1977	Jan	4WD	1025	46	4.5
1977	Jun	4XQ	254	15	5.9
1977	Jul	4XS	6541	525	8.0
1977	Aug	4XO	15984	512	3.2
1977	Aug	4XR	7917	173	2.2
1977	Aug	4XS	15894	3302	20.8
1977	Sep	4XO	12321	391	3.2
1977	Sep	4XQ	11044	298	2.7
1977	Sep	4XR	7000	127	1.8
1977	Nov	4VN	588	36	6.1
1977	Dec	4VN	2494	117	4.7
1978	Jan	4WD	4795	607	12.7
1978	Feb	4XS	50	3	6.0
1978	Mar	4XS	3949	32	0.8

Appendix 2. 3(con't).

Year	Month	NAFO Area	Number Released	Number Recovered	Percent Recovered
1978	Apr	4XO	9991	4	0.0
1978	Jul	4XR	15097	336	2.2
1978	Aug	4XS	2375	121	5.1
1978	Oct	4TG	8000	92	1.2
1978	Nov	4VN	3178	169	5.3
1978	Nov	4WD	364	33	9.1
1978	Dec	4VN	816	35	4.3
1978	Dec	4WD	3364	288	8.6
1979	Jan	4WD	299	25	8.4
1979	Mar	4XO	10325	93	0.9
1979	Jun	4XR	9092	618	6.8
1979	Sep	4XS	2900	70	2.4
1979	Oct	4XS	2025	43	2.1
1979	Dec	4VN	4554	504	11.1
1980	Jan	4VN	6151	577	9.4
1980	Apr	4XM	3639	19	0.5
1980	May	4WD	7286	132	1.8
1980	Jun	4XO	10036	136	1.4
1980	Jul	4XR	1025	40	3.9
1980	Jul	4XS	3708	417	11.3
1981	Apr	4VN	2225	37	1.7
1981	May	4VN	750	4	0.5
1981	Jul	4XS	9515	144	1.5
1981	Sep	4XS	9290	484	5.2
1981	Oct	4TG	10298	32	0.3
1982	Apr	4WD	7117	17	0.2

Appendix 2. 4. Herring Tag Recovery Reductions due to information deficiencies in the 1973-82 study period.

	Number	Percent Recovered
Total Number Released	341091	
Total Number Recovered	13806	4.0
CUMULATIVE RECOVERY REDUCTIONS DUE TO INFORMATION DEFICIENCY		
Number with at least NAFO Division only as Recovery Location	13724	4.0
plus Year of Recapture	12910	3.8
plus Month of Recapture	12641	3.7

Appendix 2. 5. Temporal breakdown of herring recovery data from the 1973-82 tagging studies.

	Number	Percent Recovered
Total Number Released	341091	
Number Recovered with date of Recovery known to Month	13066	3.8
RECOVERIES BASED ON PERIODS AT-LARGE		**Percent of Recoveries**
Recovery within 3 Months of Release	8605	65.9
Recovery Between 3 Months and 1 Year of Release	3167	24.2
Recovery Between 1 and 2 Years of Release	944	7.2
Recovery Between 2 and 3 Years of Release	241	1.8
Recovery Between 3 and 4 Years of Release	75	0.6
Recovery Over 4 Years after Release	34	0.3

Appendix 2. 6. Herring Length Frequencies associated with tagging studies, November, 1973 to February, 1976.

NAFO Area	4Xs	4Xq	4Xr	4Xs	4Tf	4Tm	4Tn	4Wd
Year	1973	1974	1974	1974	1976	1976	1976	1976
Month	NOV-DEC	AUG	AUG	JUN-JUL	MAY	SEP	AUG-SEP	FEB
Length								
10								
11				11				
12				11				
13				32				
14	127			64				
15				96				
16	43			122				
17	42			1207				27
18	448			352				201
19	880	55		449		28		873
20	477	55		630				3706
21	202	55		546		106		2698
22	177	55		554		247		746
23	376			543		176	32	451
24	418		49	1027		459	57	72
25	836	329	99	1513		2696	1001	53
26	1506	165	607	1269	17	3352	4978	23
27	753	439	1827	644	17	940	3873	
28	84	1700	3240	748	75	144	1884	
29	42	2194	5279	566	462	101	739	
30	42	823	3672	214	1471	133	589	
31		110	746	13	2121	20	309	
32			629		853	33	667	
33			541		489	71	585	
34			906		1133		222	
35			365		971	5	176	
36					523		170	
37					90		112	
38							59	
39							91	
40								

Appendix 2. 6 (con't). Herring Length Frequencies associated with tagging studies, January to September, 1977.

NAFO Area	4Wd	4Vn	4Xq	4Xs	4Xo	4Xr
Year	1977	1977	1977	1977	1977	1977
Month	JAN	NOV-DEC	JUN-SEP	JUL-AUG	AUG-SEP	AUG-SEP
Length						
9						
10				67		
11				100		
12				67		
13						
14						
15				344		
16				1440		
17				2599	197	
18				2505	197	
19				1522	98	
20				499		
21				735	101	
22			38	325	98	56
23	10		113	147	101	
24	10	6	38	288	89	
25	78	6		670	197	
26	130		38	723	326	6
27	219	8	143	560	2954	223
28	193	24	1158	993	4857	678
29	125	73	1335	1672	5589	1555
30	42	144	525	1107	2596	1504
31	83	349	581	559	2459	1631
32	47	370	1084	794	2220	2855
33	52	364	1149	656	1662	3735
34	16	370	724	155	439	1578
35	10	439	38	9	128	436
36	5	455	70	14		78
37	5	197				56
38		138				18
39		71				56
40		27				
41		6				
42						

Appendix 2. 6 (con't). Herring Length Frequencies associated with tagging studies, January, 1978 to January, 1979.

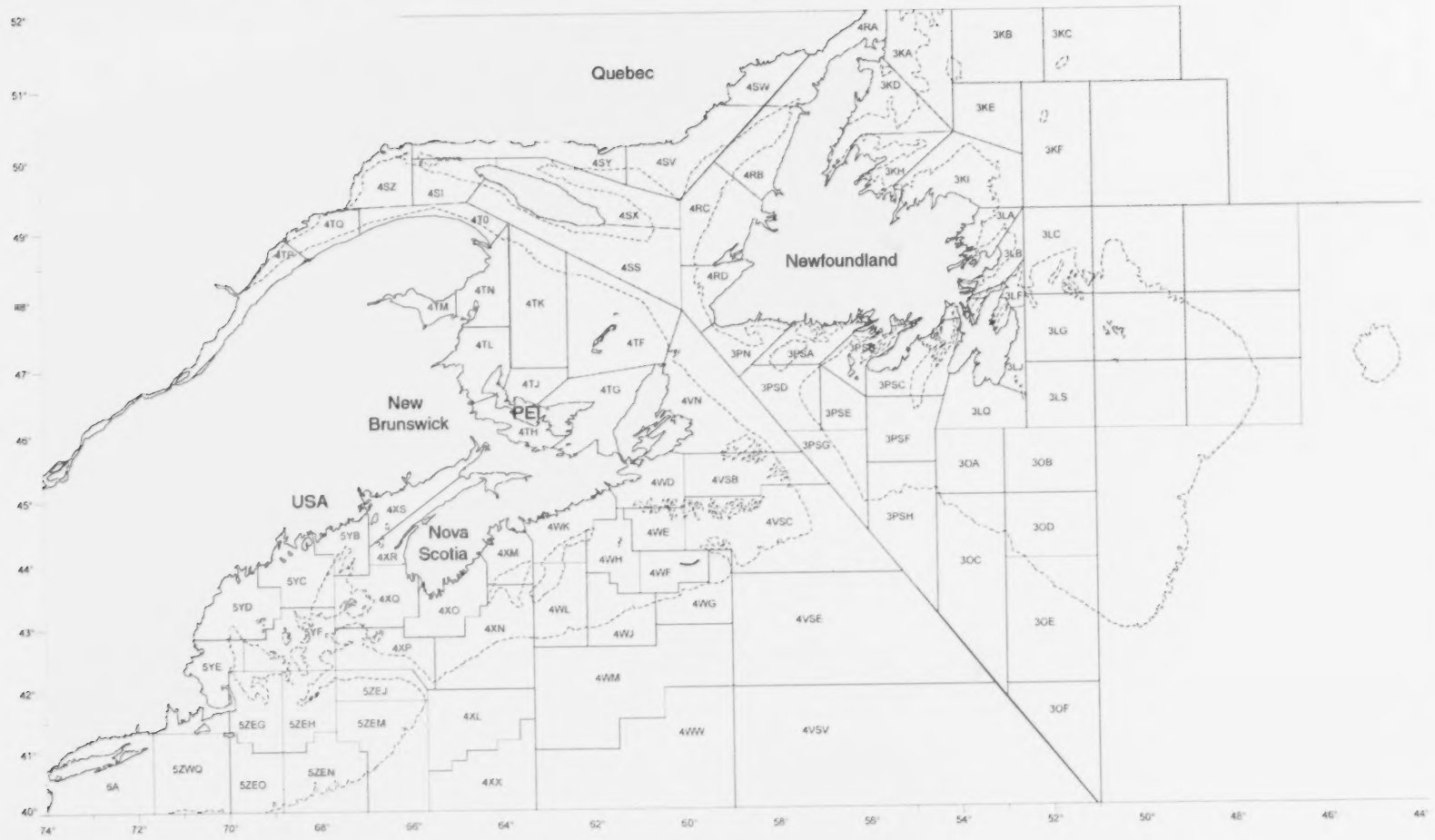
NAFO Area	4Wd	4Xo	4Xr	4Xs	4Tg	4Vn	4Wd
Year	1978	1978	1978	1978	1978	1978	1978-79
Month	JAN	APR	JUL	AUG	OCT	NOV-DEC	NOV-DEC/78 + JAN/79
Length							
9							
10		178	67				
11		870	179				
12		1015	548				
13		1419	2117				
14		1577	2125				
15		1845	1020				
16		1647	1078		40		
17		569	1125		24	7	
18		189	770		217	14	
19		47	785	14	354	21	
20		18	617	85	361		9
21	12	102	422	28	241		23
22	41	214	82	85	304		4
23	59	123	157	254	314	14	81
24	95	132	187	339	990	7	45
25	80	47	63	396	1846	43	2
26	120		144	509	1082	21	17
27	231		46	495	533	21	32
28	693		55	113	588	51	97
29	1093		142	28	376	199	110
30	732		527	14	282	250	187
31	443		734		141	141	200
32	356		644	14	188	153	493
33	272		470		47	267	565
34	171		570		47	363	708
35	119		196			466	747
36	138		30			473	440
37	69		16			690	171
38	33					267	79
39	32					100	17
40	6					74	12
41	1					6	
42							

Appendix 2. 6 (con't). Herring Length Frequencies associated with tagging studies, December, 1979 to January, 1980.

NAFO Area	4Vn	4Xo	4Xr	4Xs	4Vn
Year	1979	1979	1979	1979	1980
Month	DEC	MAR	JUN	SEP-OCT	JAN
Length					
10		9			
11					
12					
13			58		
14			356		
15		9	918		
16		9	1059		
17		64	1530		
18		162	704		
19		435	732		
20		989	749		
21	7	1910	1157	21	
22	123	2310	966	87	53
23	397	2607	449	66	354
24	849	1216	242	307	755
25	810	307	176	467	944
26	633	112		943	416
27	269	91		939	159
28	697	58		729	318
29	441	27		594	243
30	183			471	328
31	28	9		211	307
32	32			73	312
33	10			17	264
34	7				267
35	16				289
36	2				344
37					284
38	1				281
39					95
40					46
41	1				6
42					6
43					

Appendix 2. 6 (con't). Herring Length Frequencies associated with tagging studies, April, 1980 to September, 1981.

NAFO Area	4Xm	4Wd	4Xo	4Xr	4Xs	4Vn	4Xs
Year	1980	1980	1980	1980	1980	1981	1981
Month	APR	MAY	JUN	JUL	JUL	APR-MAY	JUL-SEP
Length							
13							
14							75
15							181
16				13			243
17							402
18				19			885
19						7	1824
20			50	31			2258
21	50		99	94			1845
22	125		248	125	5	14	916
23	224	12	198	113	30	77	512
24	349		297	63	48	124	225
25	548	58	990	75	139	116	128
26	922	92	1683	100	233	167	352
27	897	69	2178	194	619	224	806
28	424	115	2277	94	751	481	1510
29	100	46	1238	50	417	391	3021
30		46	495	25	247	237	2215
31		69	50	13	98	233	1208
32		23			82	108	101
33		58	99		189	66	101
34		150	50	6	246	53	
35		219			352	17	
36		242	50		163	34	
37		449		13	89		
38		311					
39		184					
40		35					
41		12					
42		12					
43							



Appendix 3.1 . Map of the northwest Atlantic, showing the NAFO unit areas referred to in this report

Appendix 3.2 The prorated herring catch matrix used to weight tag recoveries by fishing effort.

Year	Month	3PS	4RC	4RU	4SR	4SS	4ST	4SU	4SV	4SW	4TF	4TG	4TH	4TJ	4TK	4TL	4TM	4TN	4TO	4TQ	4TU	4VN	4WD	4WF	4WJ	4WK	4WU	4XM	4XN	4XO	4XP	4XQ	4XR	4XS	4XU	5YB	5YC	5YD	5YE	5YU	5ZE	5ZG	5ZH	5ZJ	5ZO	5ZQ
73	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4560	1	0	0	0	4016	0	0	0	0	0	0	1088	22	0	0	0	0	0	0	0	0	0	0	0
73	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	269	0	0	0	0	0	0	154	2	0	0	0	0	0	0	0	0	0	0	0
73	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	468	0	0	0	431	0	1235	145	0	0	0	0	0
73	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	23	0	0	570	0	1310	0	0	0	0	0	0
73	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	561	0	0	0	0	0	0
73	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	257	10955	0	0	0	3832	0	0	0	0	0	0	2362	0	0	0	0	0	0	0	0	0	0	0	0
74	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7092	0	0	0	291	1029	0	0	0	0	0	794	0	0	0	0	0	0	0	0	0	0	0	0
74	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	277	0	0	0	0	0	108	0	0	0	0	0	0
74	4	0	0	0	5	0	0	0	0	0	0	27	1	11	0	0	6	3	15	48	498	14	46	0	0	1	0	1	0	0	0	0	27	966	0	0	249	152	47	735	0	0	0	0	0	0
74	5	0	10	0	36	0	0	0	0	0	2775	28	526	10	0	2302	1108	175	88	145	1009	86	53	0	0	17	0	203	0	149	0	486	292	2015	0	0	0	0	178	0	0	0	0	0	0	72
74	6	0	0	0	21	0	7	0	0	0	11	17	181	0	0	371	230	109	177	99	0	70	74	0	0	212	0	145	8	1062	0	5361	10688	1878	27	0	0	0	95	0	0	0	0	0	0	0
74	7	0	0	0	28	0	8	0	6	2	0	3	83	0	0	25	256	606	54	58	1875	40	56	0	0	206	0	196	0	1003	0	16359	15008	6087	5300	0	0	0	0	0	0	0	0	0	0	0
74	8	0	0	0	7	65	5	0	118	228	0	24	229	0	0	210	379	802	186	29	1287	1	20	0	0	67	0	85	0	1115	0	17798	6691	7517	20	0	86	156	0	0	0	0	0	0	0	0
74	9	0	0	0	4	0	0	0	24	0	0	0	129	0	0	524	1428	3015	147	23	2019	0	0	0	0	4	0	22	0	279	0	686	1423	6241	8	0	2238	0	0	0	0	69	34	0	0	0
74	10	0	0	0	10	0	0	0	0	0	0	21	0	0	0	10	21	907	59	5	2061	30	9	0	0	0	0	35	0	9	0	0	467	3603	0	0	0	0	0	0	0	35	0	7	0	0
74	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	302	37	0	1372	4940	205	0	0	0	1018	50	0	0	0	0	1	2295	0	0	0	0	0	0	0	0	0	0	0	0
74	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	5353	16	0	0	1	2547	108	0	12	0	0	0	1328	0	0	0	0	0	0	0	0	0	0	0	0
75	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	811	10037	0	0	0	13905	0	0	0	0	0	0	297	19	0	0	0	0	0	0	0	0	0	0	0
75	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	324	0	0	0	0	0	0	131	0	0	0	0	0	0	0	0	0	0	0	0
75	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	0	0	0	0	0	0	0	0	0	0	0	0
75	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47	0	0	0	0	0	0	692	66	0	0	75	0	0	0	0	0	0	0	0
75	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	221	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	6	0	0	0	0	0	0	0	0	0	105	0	0	0	0	0	0	0	0	0	1428	77	0	0	0	0	161	0	0	0	0	244	18	4	2238	0	0	0	0	0	0	0	0	0	0	0	0
75	7	0	0	0	0	0	0	0	0	0	2807	0	0	0	0	0	0	0	0	0	7797	312	0	0	0	0	367	0	0	0	0	8124	10075	0	5676	0	0	0	0	0	0	0	0	0	0	0	0
75	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2368	1	0	0	0	0	73	0	0	0	0	12347	5374	9779	13360	57	0	0	0	739	0	0	0	0	0	0	0
75	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3179	0	0	0	0	0	7	0	0	0	0	530	1059	0	13375	0	0	0	1678	0	0	0	0	0	0	0	0
75	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5067	4	0	0	0	0	0	0	0	0	0	0	327	883	4607	0	0	0	0	0	0	0	0	0	0	0	0
75	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1372	2405	57	0	0	0	0	0	0	0	0	0	0	628	429	22	0	0	0	0	0	0	0	0	0	0	0
75	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3038	7578	0	0	281	51	0	0	0	0	0	0	41	87	0	0	0	0	0	0	0	0	0	0	0	0
76	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17406	0	0	0	0	479	1	0	0	0	0	98	0	0	0	0	0	0	0	0	0	0	0	0	0
76	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6644	0	0	0	0	44	0	0	0	0	0	462	19	0	0	0	0	0	0	0	0	0	0	0	0
76	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	75	0	0	0	0	0	0	0	0	0	0	0	0	0
76	4	0	0	0	0	0	0	0	0	0	3399	2	85	18	0	30	47	1	34	35	210	3	134	0	0	0	8	0	1	0	2	0	12	9	0	0	0	0	0	0	0	0	0	0	0	0	0
76	5	0	0	484	22	0	2	0	0	0	2706	26	596	8	0	2628	813	159	170	441	3153	18	71	0	0	8	0	80	0	52	0	3	1163	128	0	0	0	0	0	0	0	0	0	0	0	0
76	6	0	0	0	9	0	4	0	16	34	0	21	35	5	0	59	295	373	118	24	0	43	16	0	0	167	0	276	0	1596	63	1553	7061	1647	0	0	0	0	0	0	0	0	0	0	0	0
76	7	0	0	0	5	0	0	0	37	30	0	1	86	0	0	3	31	24	18	29	2	13	24	0	0	36	0	109	0	459	0	4102	10915	9566	155	0	0	0	0	0	0	0	0	0	0	0	0
76	8	0	0	0	3	0	4	0	92	142	0	0	113	0	0	32	778	103	40	14	0	0	8	0	0	7	0	16	0	648	0	11714	7535	11054	27	0	0	0	0	921	0	0	0	0	0	0	0
76	9	0	0	0	1	0	4	0	44	22	0	0	243	0	0	549	664	280	56	14	0	0	0	0	0	2	0	21	0	733	0	13509	960	13246	22	0	0	0	0	0	0	0	0	0	0	0	0
76	10	16	0	0	0	0	0	0	0	0	56	1	14	0	0	6	34	3589	54	17	1473	196	1	0	0	3	0	29	0	43	0	1967	686	1575	0	0	0	0	0	0	0	0	0	0	0	0	0
76	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4945	20	2	2002	3830	99	0	0	0	0	0	0	0	0	0	3	871	0	0	0	0	0	0	0	0	0	0	0	0
76	12	0	0	0	0	0	0	0	0	0	123	0	0	0	0	0	0	202	0	0	0	6329	5517	0	0	0	45	10	0	5	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 3.2 (con't). The prorated herring catch matrix used to weight tag recoveries by fishing effort.

Year	Month	3PS	4RC	4RU	4SR	4SS	4ST	4SU	4SV	4SW	4TF	4TG	4TH	4TJ	4TK	4TL	4TM	4TN	4TO	4TQ	4TU	4VN	4WD	4WF	4WJ	4WK	4WU	4XM	4XN	4XO	4XP	4XQ	4XR	4XS	4XU	5YB	5YC	5YD	5YE	5YU	5ZE	5ZG	5ZH	5ZJ	5ZO	5ZQ
77	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9255	0	0	0	4740	0	0	0	0	0	0	27	1	0	0	0	0	0	0	0	0	0	0	0
77	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	124	0	0	0	0	0	0	0	0	0	0	406	342	0	0	0	0	0	0	0	0	0	0	0
77	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0
77	4	0	0	0	1	0	0	1	0	0	431	0	0	0	0	0	0	0	0	0	1045	0	715	0	0	0	92	0	0	0	0	0	0	0	4	0	0	0	0	70	0	0	0	0	0	0
77	5	0	0	0	0	0	0	1	0	0	3490	0	0	0	0	0	0	0	0	0	3403	61	2065	0	0	0	63	195	0	0	0	663	118	0	947	0	0	0	0	311	0	0	0	0	0	0
77	6	0	4	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	8853	3826	0	0	0	0	178	0	0	0	0	6474	8419	29	5323	0	0	0	0	0	0	0	0	0	0	0
77	7	0	0	0	0	0	0	64	0	0	0	0	0	0	0	0	0	0	0	0	244	9	0	0	0	0	366	0	0	0	0	7427	8133	1863	11728	0	0	0	0	0	0	0	0	0	0	0
77	8	0	0	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0	2126	0	0	0	0	0	525	0	0	0	0	11526	2989	439	16697	0	0	0	0	0	0	0	0	0	0	0
77	9	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	53	0	0	1096	0	0	0	0	0	31	0	0	122	0	4499	5863	0	9005	0	0	0	0	0	0	0	0	0	0	0
77	10	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	3361	0	0	3805	2	0	0	0	0	3	0	0	0	0	1143	72	0	3200	0	0	0	0	0	0	0	0	0	0	0
77	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	5076	0	0	3594	3438	94	2	0	0	154	0	0	0	0	0	0	0	3648	0	0	0	0	0	0	0	0	0	0	0
77	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	0	0	524	3632	0	0	0	0	66	0	0	0	0	0	0	0	538	0	0	0	0	0	0	0	0	2	0	0
78	1	0	0	0	0	0	0	0	0	0	0	115	0	0	0	0	0	0	0	0	125	3562	9811	0	0	0	4232	0	0	21	0	0	0	1385	8	0	0	0	0	0	0	0	0	0	0
78	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1162	0	0	0	123	0	0	0	0	0	0	0	0	0	0	0	0
78	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	262	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0
78	4	0	0	0	0	0	0	1	0	0	0	1	6	0	0	23	3	0	9	0	720	31	0	0	0	1	0	0	0	0	0	0	14	200	14	0	0	0	0	0	0	0	0	0	0	0
78	5	0	0	0	0	0	0	0	0	0	0	147	414	25	446	3489	518	2242	0	0	1863	177	77	0	0	386	0	412	0	489	0	152	513	520	0	0	0	390	0	0	0	0	0	0	0	0
78	6	0	0	0	0	0	0	0	0	0	0	32	52	0	0	283	165	1	0	0	0	102	42	0	0	441	0	451	71	2320	0	13407	4308	1152	21	0	0	192	0	0	0	0	0	0	0	0
78	7	0	0	0	0	0	0	0	0	0	0	4	107	0	0	52	77	41	0	0	6	2	1	0	0	604	0	91	64	1028	0	19020	3777	5923	7	0	0	0	0	0	0	0	0	0	0	0
78	8	0	0	0	0	0	0	0	0	0	0	1	144	0	0	45	578	1150	0	0	49	0	1	0	0	229	0	97	0	171	0	13040	885	11886	141	0	0	0	0	0	0	0	0	0	0	0
78	9	0	0	0	0	0	0	0	0	0	0	243	258	0	0	445	45	2165	0	0	6321	0	0	0	0	41	0	74	23	37	0	4291	144	12425	3456	0	0	0	0	0	0	0	0	0	0	0
78	10	0	0	0	0	0	0	0	0	0	0	554	11	0	0	384	8	905	0	0	11421	0	0	0	0	3	0	14	5	7	0	225	111	6692	5816	0	0	0	0	0	0	0	0	0	0	0
78	11	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	25	0	0	0	6838	2244	50	0	0	1	164	1	0	1	0	0	198	1012	398	0	0	0	0	0	0	0	0	0	0	0
78	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	787	0	0	0	2061	605	592	0	0	0	6774	4	0	0	0	0	79	132	49	0	0	0	0	0	0	0	0	0	0	0
79	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2528	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	1400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	4	0	0	0	0	0	0	0	0	0	11046	64	70	16	0	48	4	5	0	0	188	99	166	0	0	19	0	5	6	579	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
79	5	0	0	0	0	0	0	0	0	0	381	73	480	95	0	3259	488	43	0	0	0	154	196	0	0	400	0	123	0	170	0	0	850	41	243	0	0	0	0	0	0	0	0	0	0	0
79	6	0	0	0	0	0	0	0	0	0	0	29	9	1	0	225	197	28	0	0	0	64	27	0	0	595	0	165	16	867	0	390	3747	1198	1637	0	0	0	0	0	0	0	0	0	0	0
79	7	0	0	0	0	0	0	0	0	0	0	11	221	0	0	9	24	18	0	0	0	14	6	0	0	388	0	52	0	748	0	1055	3014	7400	5960	0	0	0	0	0	0	0	0	0	0	0
79	8	0	0	0	0	0	0	0	0	0	0	64	454	0	0	131	65	223	0	0	381	0	13	0	0	49	0	35	0	391	0	2840	3356	10102	3823	0	0	0	0	0	0	0	0	0	0	0
79	9	0	0	0	0	0	0	0	0	0	0	93	389	0	0	813	48	1741	0	0	2423	0	12	0	0	34	0	22	0	203	0	4838	961	5179	3591	0	0	0	0	0	0	0	0	0	0	0
79	10	0	0	0	0	0	0	0	0	0	0	1	9	0	0	176	85	392	0	0	3849	0	1	0	0	0	9	7	0	101	0	1021	228	6606	1119	0	0	0	0	0	0	0	0	0	0	0
79	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	12	47	0	0	8500	8	24	0	0	2	191	19	0	11	0	0	57	2732	217	0	0	0	0	0	0	0	0	0	0	0
79	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2305	798	77	0	0	0	500	6	0	0	0	0	0	74	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 3.2 (con't). The prorated herring catch matrix used to weight tag recoveries by fishing effort.

Year	Month	3PS	4RC	4RU	4SR	4SS	4ST	4SU	4SV	4SW	4TF	4TG	4TH	4TJ	4TK	4TL	4TM	4TN	4TO	4TQ	4TU	4VN	4WD	4WF	4WJ	4WK	4WU	4XM	4XN	4XO	4XP	4XQ	4XR	4XS	4XU	5YB	5YC	5YD	5YE	5YU	5ZE	5ZG	5ZH	5ZJ	5ZO	5ZQ
80	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	2220	325	0	0	0	5632	0	0	0	0	0	6	0	781	0	0	0	0	0	0	0	0	0	0	0
80	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	3	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	0	1016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	95	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	5	0	0	0	0	0	0	0	0	0	0	4144	13	19	16	0	8	18	0	0	0	4154	15	309	0	0	0	0	0	0	0	0	0	284	94	38	17	0	0	0	0	0	0	0	0	0	0	0
80	6	0	0	0	0	0	0	0	0	0	0	2068	124	617	0	0	1623	709	50	0	0	2022	105	209	0	0	56	0	51	0	10	0	2894	0	1561	155	1467	0	0	0	0	0	0	0	0	0	0	0
80	7	0	0	0	0	0	0	0	0	0	0	0	24	146	0	0	109	24	3	0	0	0	116	98	0	0	649	0	252	0	1578	0	5141	1561	155	1467	0	0	0	0	0	0	0	0	0	0	0
80	8	0	0	0	0	0	0	0	0	0	0	0	12	177	4	0	84	56	12	0	0	0	23	17	0	0	400	0	151	0	896	0	7793	2766	1988	10372	0	0	0	0	0	0	0	0	0	0	0
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80	10	0	0	0	0	0	0	0	0	0	0	0	329	348	0	0	578	119	186	0	0	24	0	9	0	0	49	0	190	0	219	0	4719	622	2352	2754	0	0	0	0	0	0	0	0	0	0	0	0
80	11	0	0	0	0	0	0	0	0	0	0	0	35	6	0	0	20	26	67	0	0	7984	2	0	0	0	33	0	141	0	9	0	766	85	1016	671	0	0	0	0	0	0	0	0	0	0	0	0
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82	1	0	0	0	0	0	0	0	0	0	0	1	25	0	0	0	24	0	0	0	1154	2483	2195	0	0	0	9	0	4	0	6	0	58	1905	0	0	0	0	0	0	0	0	0	0	0	0	0
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82	10	0	0	0	0	0	0	0	0	0	0	43	190	2	0	31	10	163	0	0	1	34	3	0	0	0	171	0	328	0	867	0	1959	355	7891	21867	0	0	0	0	0	0	0	0	0	0	0	0
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83	10	0	0	0	0	0	0	0	0	0	0	35	285	8	0	311	285	75	0	0	0	0	10	0	0	0	75	8	134	0	241	0	0	272	299	15630	0	0	0	0	0	0	0	0	0	0	0	0
83	11	0	0	0	0	0	0	0	0	0	0	217	147	6	0	218	68	193	0	0	0	0	0	1	0	0	58	0	125	0	409	0	1773	590	2625	22530	0	0	0	0	0	0	0	0	0	0	0	0
83	12	0	0	0	0	0	0	0	0	0	0	2528	650	15	0	849	1455	3658	0	0	74	0	0	1	0	0	27	0	12	0	486	0	3248	1090	5724	18602	0	0	0	0	0	0	0	0	0	0	0	0
83	9	0	0	0	0	0	0	0	0	0	0	786	383	5	0	385	786	331	0	0	60	0	1	0	0	0	12	0	5	0	4	0	1	168	7237	1463	0	0	0	0	0	0	0	0	0	0	0	0
83	10	0	0	0	0	0	0	0	0	0	0	0	2	0	0	5	2	2	0	0	2149	0	0	0	0	0	2	0	2	0	0	0	0	18	951	0	0	0	0	0	0	0	0	0	0	0	0	0
83	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1290	2005	2790	0	0	0	0	0	16	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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